



## The Deshayesitidae Stoyanov, 1949 (Ammonoidea) of the Aptian historical stratotype region at Cassis-La Bédoule (SE France)

Pierre Ropolo, Michel Moullade, Roland Gonnet, Gabriel Conte, Guy Tronchetti

### ► To cite this version:

Pierre Ropolo, Michel Moullade, Roland Gonnet, Gabriel Conte, Guy Tronchetti. The Deshayesitidae Stoyanov, 1949 (Ammonoidea) of the Aptian historical stratotype region at Cassis-La Bédoule (SE France). *Carnets de Geologie*, 2006, CG2006 (M01), pp.1-46. hal-00167128

**HAL Id: hal-00167128**

**<https://hal.science/hal-00167128>**

Submitted on 15 Aug 2007

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# The Deshayesitidae STOYANOV, 1949 (Ammonoidea) of the Aptian historical stratotype region at Cassis-La Bédoule (SE France)

Pierre ROPOLLO<sup>1</sup>

Michel MOULLADE<sup>2</sup>

Roland GONNET<sup>3</sup>

Gabriel CONTE<sup>4</sup>

Guy TRONCHETTI<sup>5</sup>

**Abstract:** One of the significant results of the multidisciplinary investigations carried out during recent years in the Lower Aptian historical stratotype of the Cassis-La Bédoule region (South-Eastern France) was a proposal to update the local Upper Barremian/Lower Aptian ammonite biozonation in order to be more consistent with the standard Mediterranean zonal subdivisions. So the lower and upper boundaries of the Lower Aptian (= Bedoulian substage of most French authors) as well as the boundaries of four biozones (*Paradeshayesites tuarkyricus*, *P. weissii*, *Deshayesites deshayesi*, *Dufrenoyia furcata* zones) and two subzones (*Roloboceras hambrovi* and *Paradeshayesites grandis* subzones) were identified and formally defined in the stratotype. However, to support this zonal scheme additional descriptions and illustrations of the ammonites collected bed by bed in the several sections studied were still required. In this paper we describe the members of the most significant ammonite family found in the Lower Aptian of Cassis-La Bédoule, *i.e.* the Deshayesitidae, and delimit precisely their stratigraphic positions. As regards zonation, we have replaced the index ammonite of the earliest Bedoulian Zone, *i.e.* *Paradeshayesites tuarkyricus* (BOGDANOVA, 1983), by *Paradeshayesites oglanlensis* (BOGDANOVA, 1983), and re-established the *Pseudocrioceras waagenoides* Zone as a subzone.

**Key Words:** Cretaceous, Aptian, ammonites, Deshayesitidae, markers, biozonation, taxonomy, stratigraphy

**Citation:** ROPOLLO P., MOULLADE M., GONNET R., CONTE G. & TRONCHETTI G. (2006).- The Deshayesitidae STOYANOV, 1949 (Ammonoidea) of the Aptian historical stratotype region at Cassis-La Bédoule (SE France).- [Carnets de Géologie / Notebooks on Geology](#), Brest, Memoir 2006/01 (CG2006\_M01)

**Résumé :** *Les Deshayesitidae STOYANOV, 1949 (Ammonoidea) de la région du stratotype historique de l'Aptien à Cassis-La Bédoule (SE France).*- L'un des résultats significatifs de recherches multidisciplinaires poursuivies ces dernières années dans la région stratotypique de l'Aptien inférieur à Cassis-La Bédoule (SE France) fut de proposer pour le Barrémien supérieur et l'Aptien inférieur une mise à jour de la biozonation locale par ammonites qui soit plus en accord avec les subdivisions zonales standard du domaine méditerranéen. Ainsi les limites inférieure et supérieure de l'Aptien inférieur (= sous-étage bédoulien des auteurs français) de même que les limites de quatre biozones (à *Paradeshayesites tuarkyricus*, *P. weissii*, *Deshayesites deshayesi*, *Dufrenoyia furcata*) et de deux sous-zones (à *Roloboceras hambrovi* et *Paradeshayesites grandis*) ont été reconnues et formellement définies dans le stratotype. Il convenait, à l'appui de ce schéma zonal, de décrire et figurer les ammonites recueillies banc par banc dans les diverses coupes étudiées. Le but du présent article est donc de décrire et de situer stratigraphiquement les représentants de la famille la plus significative parmi les ammonites de l'Aptien inférieur de Cassis-La Bédoule, à savoir les Deshayesitidae. En ce qui concerne la zonation, nous avons remplacé dans un nouveau schéma zonal l'ex-forme-index de la première zone du Bédoulien, *Paradeshayesites tuarkyricus* (BOGDANOVA, 1983), par l'espèce *Paradeshayesites oglanlensis* (BOGDANOVA, 1983), et rétabli la zone à *Pseudocrioceras waagenoides* au rang de sous-zone.

<sup>1</sup> Centre de Sédimentologie-Paléontologie, CNRS UMR 6019, Université de Provence Marseille-Saint-Charles (France) & Centre d'Études Méditerranéennes, Barrême (France) - Correspondance: 83 Bd. du Redon, Bât. E-9, La Rouvière 13009 Marseille (France)  
[ropollo.geol@wanadoo.fr](mailto:ropollo.geol@wanadoo.fr)

<sup>2</sup> Centre de Sédimentologie-Paléontologie, CNRS UMR 6019, Université de Provence Marseille-Saint-Charles (France) & Centre de Recherches Micropaléontologiques, Muséum d'Histoire Naturelle, 60 Bd. Risso, 06000 Nice (France)  
[michel.moullade@unice.fr](mailto:michel.moullade@unice.fr)

<sup>3</sup> Centre d'Études Méditerranéennes, Barrême (France)

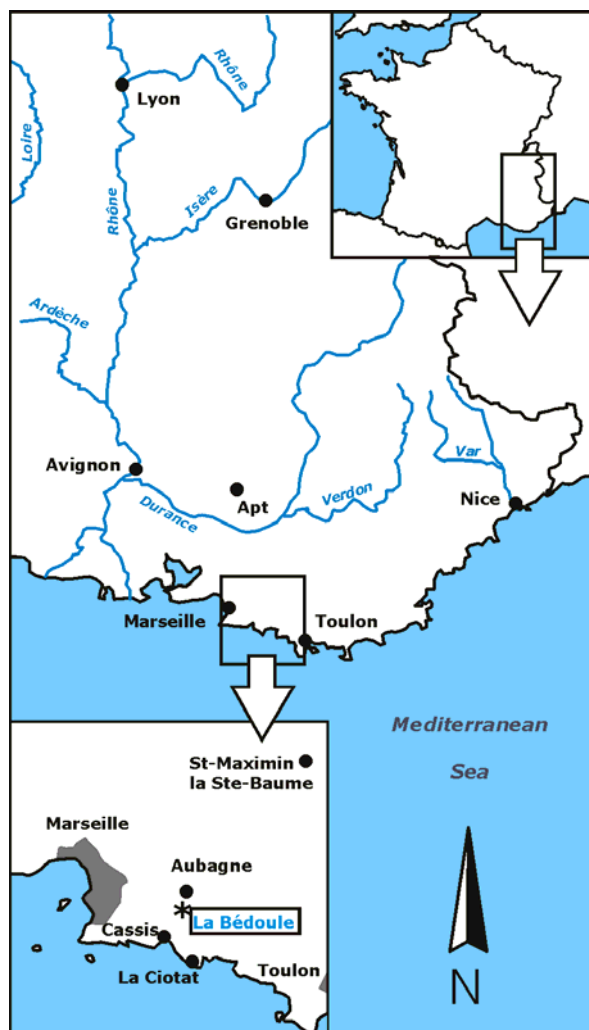
<sup>4</sup> 9, Rue St Castor, 30000 Nîmes (France)

<sup>5</sup> Centre de Sédimentologie-Paléontologie, CNRS UMR 6019, Université de Provence Marseille-Saint-Charles (France)

**Mots-Clefs** : Crétacé, Aptien, ammonites, Deshayesitidae, marqueurs, biozonation, taxinomie, stratigraphie

## Introduction

Over the years the outcrops of the Lower Aptian stratotype in the Cassis-La Bédoule area (SE France) (Fig. 1) have been studied by many authors, including MATHERON (1842, 1878-1880), REYNÈS (1861), HÉBERT (1871), TOUCAS (1888), ROCH (1927), BLANC (1958), FABRE-TAXY *et alii* (1965), FLANDRIN (1965), MOULLADE *et alii* (1980), BUSNARDO (1984), CONTE (1994), MOULLADE *et alii* (1998, 2000a), ROPOLO *et alii* (2000a, 2000b, 2000c), ROPOLO & GONNET (1999), and CECCA *et alii* (1999, 2000).



**Figure 1:** Location of the Cassis-La Bédoule area.

HÉBERT (1871) was the first to give a lithologic and to some extent a "biostratigraphic" description of the stratotype outcrops, because his description is based on a succession of levels more or less characterized by fossils. The sequence was divided initially into two ammonite zones by KILIAN & REBOUL (1915) and by ROCH (1927); later it was regarded as a single zone by FABRE-TAXY *et alii* (1965). BUSNARDO (1984) divided the Lower Aptian of Cassis-La Bédoule into seven zones, from bottom to top: the "*Prodeshayesites*", *Pseudocrioceras coquandi*, *Deshayesites consobrinus*, *Ancyloceras matheroni*, *Roloboceras hambrovi*, *Deshayesites grandis*

and *Tropaeum bowerbanki* zones. Because it appeared difficult to apply this local zonation elsewhere, such a subdivision was not retained for the Mediterranean region at the several Workshops of the Lower Cretaceous Cephalopod Team of IGCP projects 262/362 (Digne 1990 - Mula 1992 - Piobbico 1994 - London 1997). Instead they proposed the ammonite zonation used in the Transcaspian region (Turkmenia), which consists of four zones (from bottom to top: the *Deshayesites turkryicus*, *D. weissii*, *D. deshayesi* and *Dufrenoyia dufrenoyi* zones).

Too, during the last decade reservations have been expressed (BOGDANOVA & TOVBINA, 1994; ERBA, 1996; BOGDANOVA & MIKHAILOVA, 1999; BARRAGÁN-MANZO & MENDES-FRANCO, 2005) concerning the concept of "*Bedoulian*" (TOUCAS, 1888) (= the "*Cassis-La Bédoule Formation*" pro parte, MOULLADE *et alii*, 2000b) defined in its historical stratotype by the French authors as the Lower Aptian substage. The main objections raised were:

1) no thorough paleontological revision of the ammonite content of the stratotype had been published after 1965 despite the recommendations made at the Lyon Colloquium (1963) and

2) the stratigraphic scheme published by BUSNARDO (1984) (without systematic descriptions or illustrations) could not be applied elsewhere. Consequently, several localities in the Caucasian and Transcaspian regions were proposed as "*parastratotypes*" (BOGDANOVA & PROZOROVSKY, 1999) with the intention of clarifying the then current stratigraphic and palaeontologic knowledge which would lead to the establishment of a basis for of an Aptian "*standard*" zonation of the Mediterranean Realm.

This prospect emphasized the necessity for an update and revision of Uppermost Barremian/Lower Aptian stratigraphy in SE France and more particularly in the historical stratotype area. New investigations were undertaken by an international multidisciplinary team in various sections of the Cassis-La Bédoule area. In carrying out this revision the methods of integrated stratigraphy were used: a combination of the study of the several macro- and microfossils groups, together with a detailed examination of the sedimentological and geochemical (trace-elements and stable isotopes) characteristics of the associated rocks. The results were published in a synthesis volume (MOULLADE *et alii*, 2000a).

The new data thus obtained from the Lower Aptian historical stratotype area led us to propose a stratigraphic subdivision which was more closely in agreement with the recently proposed Mediterranean zones and permitted a partial correlation of the standard zonation with that of the Boreal realm (ROPOLO *et alii*, 2000b, 2000c; MOULLADE *et alii*, 2000c). The main

paleontological (ammonites) and biostratigraphic results published in this synthesis were:

- the description of an uppermost Barremian fossil-rich (*Pseudocrioceras*) level, presumably equivalent to the *Pseudocrioceras coquandi* Zone of BUSNARDO (1984), which allowed us to establish a formal *Pseudocrioceras waageni* Subzone in the upper portion of the *Martelites sarasini* Zone (ROPOLO *et alii*, 1999, 2000a, 2000b, 2000c; CECCA *et alii*, 1999, 2000). This Subzone was later modified as a *P. waagenoides* Zone (HOEDEMAEKER & RAWSON, 2000) and it was suggested that this zone could be used throughout the whole Tethyan realm.
- the definition of the lower boundary of the Bedoulian substage (therefore the Barremian/Aptian boundary) at the FAD (first appearance datum) of the genus *Deshayesites* (DELANOY *et alii*, 1997; MOULLADE *et alii*, 1998, 2000a; ROPOLO *et alii*, 1999; 2000c; GONNET *et alii*, 2000; ROPOLO & GONNET, 1999; CECCA *et alii*, 1999, 2000).
- the shift of the Bedoulian/Gargasian boundary, initially thought to be at bed 170 in Cassis-La Bédoule (FABRE-TAXY *et alii*, 1965), to bed 178, *i.e.* the top of the *Dufrenoyia furcata* Zone (CONTE, 1994; MOULLADE *et alii*, 1998, 2000b; ROPOLO *et alii*, 2000b; ROPOLO & GONNET, 2003).
- the selection of representatives of the family Deshayesitidae (*Deshayesites tuarkyriscus*, *D. weissii*, *D. deshayesi*, *Dufrenoyia furcata*) as zonal index species.

These results have confirmed the importance of the Cassis-La Bédoule area for it is the only place in Europe to present a continuous and expanded succession dated by ammonites ranging from the Upper Barremian (*Martelites sarasini* Zone) to the Lower/Middle Gargasian.

In this paper, we describe the populations of Deshayesitidae collected in the four zones of the stratotypic Lower Aptian area and define their ranges more accurately. The bed numbering used here is that defined in MOULLADE *et alii* (2000b).

### Biostratigraphy

#### Late Barremian / Early Aptian (Bedoulian) biozonation in the stratotypic area of Cassis-La Bédoule (SE France)

##### Barremian/Aptian boundary

The definition of this limit in the Tethyan Realm was recently discussed by BOGDANOVA & MIKHAILOVA (2004). These authors synonymize the basal Aptian species *Deshayesites antiquus* BOGDANOVA, 1979 and the Barremian species *Turkmeniceras tumidum* BOGDANOVA, 1971. The occurrence of the genus *Turkmeniceras* having been mentioned often at La Bédoule, although

never precisely identified or illustrated, the Russian authors assume the presence of a *Turkmeniceras* level in SE France. In fact, in spite of previous assertions (CONTE, oral communication), no specimens of this genus *sensu stricto* have ever been found in the stratotypic area. Initially we attributed to *Deshayesites antiquus* some shells which appeared to be quite like one of the type specimens of this species illustrated by BOGDANOVA (1983, Pl. 2, figs. 6 a-b). However, in 1999 the same ammonite was named *Deshayesites* aff. *antiquus* (BOGDANOVA & PROZOROVSKY, 1999, p. 68-69, Pl. 2, figs. f-g) and disappeared in subsequent Russian papers (BOGDANOVA & MIKHAILOVA, 1999, 2004). We have re-studied our specimens more thoroughly and now judge that they show no affinities with the genus *Turkmeniceras*, because all individuals in our material have narrower and less overlapping whorls. On the other hand, they show many similarities with the paratype of *Deshayesites luppovi* BOGDANOVA, 1983, CNIGR Museum 25/9442 (figs. 9 a-b, Pl. 2 in BOGDANOVA & MIKHAILOVA, 2004), with thirty bifurcated ribs by half whorl and flat or slightly convex flanks. In addition, intermediate ribs appear in the middle of the flanks, a feature which does appear to be present in *Turkmeniceras tumidum*.

The abundance of heteromorphic ammonites of the genus *Pseudocrioceras* in the uppermost Barremian beds (45-60) at Cassis-La Bédoule allowed us to individualize this horizon as a subzonal subdivision. We found no specimens of *Turkmeniceras sensu stricto* either in these levels or in the beds underlying or overlying them. Conversely, no specimen of *Pseudocrioceras* has as yet been mentioned in the *Turkmeniceras* levels of Turkmenia. According to DELANOY (oral communication, 2005) the genus *Turkmeniceras* occurs in several Vocontian localities (Angles, Barrême, Vergons) but in beds of the lowermost Aptian, slightly above the FO of *Deshayesites*. The recent revision of MOULLADE *et alii* (2000a) using integrated stratigraphy shows the succession of beds that spans the Barremian-Aptian transition to be continuous at Cassis-La Bédoule: there is no interruption in sedimentation which might have occulted here the *Turkmeniceras* level known elsewhere. Because the stratigraphic range of this genus remains uncertain, it cannot be used as a zonal index in SE France. We conclude that at Cassis-La Bédoule as well as in the Caucasus (Georgia) (KAKABADZE & KOTETISHVILI, 1995), Czech Republic (VAŠIČEK & SUMMESBERGER, 2004), Bulgaria, Colombia (HOEDEMAEKER, 2004; KAKABADZE, 2004), *etc.*, the concept of an uppermost Barremian *waagenoides* Zone as proposed by HOEDEMAEKER & RAWSON (2000) may be retained. However, at the 2nd International Meeting of the IUGS Lower Cretaceous Ammonite Working Group, the "**Kilian Group**" (Neuchâtel, Switzerland, 8



September 2005), Miguel COMPANY and Gérard DELANOY objected that *P. waagenoides* occurs mainly in shallow shelf environments and is very rare in basins. Consequently it was proposed that the former *Pseudocrioceras waagenoides* Zone be lowered to the rank of a subzone, which corresponds to the uppermost part of the *Martelites sarasini* Zone.

On the other hand, there is a general agreement that places the lower limit of the Aptian in the Mediterranean area at the FAD of the genus *Deshayesites* s.s. (= bed 60 at Cassis-La Bédoule). In addition, this datum coincides with the disappearance of most of the heteromorphic ammonites with Barremian characters, such as the representatives of the genus *Pseudocrioceras*.

***Paradeshayesites oganlensis* Zone** (Fig. 2): Convincing arguments (RAISOSSADAT, oral communication, 2002) were put forward at the 1st International Workshop of the IUGS Lower Cretaceous Ammonite Working Group ["Kilian Group"] (Lyon, 2002) for the use of *Paradeshayesites oganlensis* BOGDANOVA, 1983, rather than *Paradeshayesites tuarkyricus* BOGDANOVA, 1983, as the index-species of the basal zone of the Aptian stage. *P. oganlensis* has a wide geographic distribution, for it is found in SE France, Spain, Romania, Iran and the Transcaspien region, whereas *P. tuarkyricus* has been collected only in Turkmenistan and Iran (Kopet Dagh). Like HOEDEMAEKER & REBOULET (2003), VAŠIČEK & SUMMESBERGER (2004), BARRAGÁN-MANZO & MÉNDEZ-FRANCO (2005), we have chosen to select *P. oganlensis* as the index of the lowermost zone of the Aptian.

***Paradeshayesites weissii* Zone:** According to CASEY (personal communication, 2000) and to BOGDANOVA & MIKHAILOVA (2004, p. 194) the term "*weissii* Zone" should be considered unacceptable, for *P. weissii* is a *nomen dubium*. The specimens figured by NEUMAYR & UHLIG (1881) and by KOENEN (1902) are different and in any case the types are lost. CASEY has not been able to trace any specimen in the German museums that could be designated as a neotype. For the time being we preserve the usual denomination until a new index, subject to general approval, is selected. *Deshayesites consobrinus*, chosen by BUSNARDO (1984), is a good candidate, for it is the index species for a sequence nearly equivalent to and including the range of *Paradeshayesites weissii*.

***Deshayesites deshayesi* Zone:** In the Cassis-La Bédoule section, we have tentatively placed the base of the *D. deshayesi* Zone at bed 129, where we collected the first specimens of this index species. A hiatus may exist at this level (MOULLADE *et alii*, 2000c; RENARD *et alii*, 2000). This hypothesis is based on 1) the sharp lithologic contrast between the underlying more calcareous Unit 3 and the overlying more marly Unit 4, 2) the thin yellowish crust that

separates these units, interpreted as an indication of a hardground, 3) geochemical evidence. Such a gap might include part of the *D. deshayesi* and/or *P. weissii* zones.

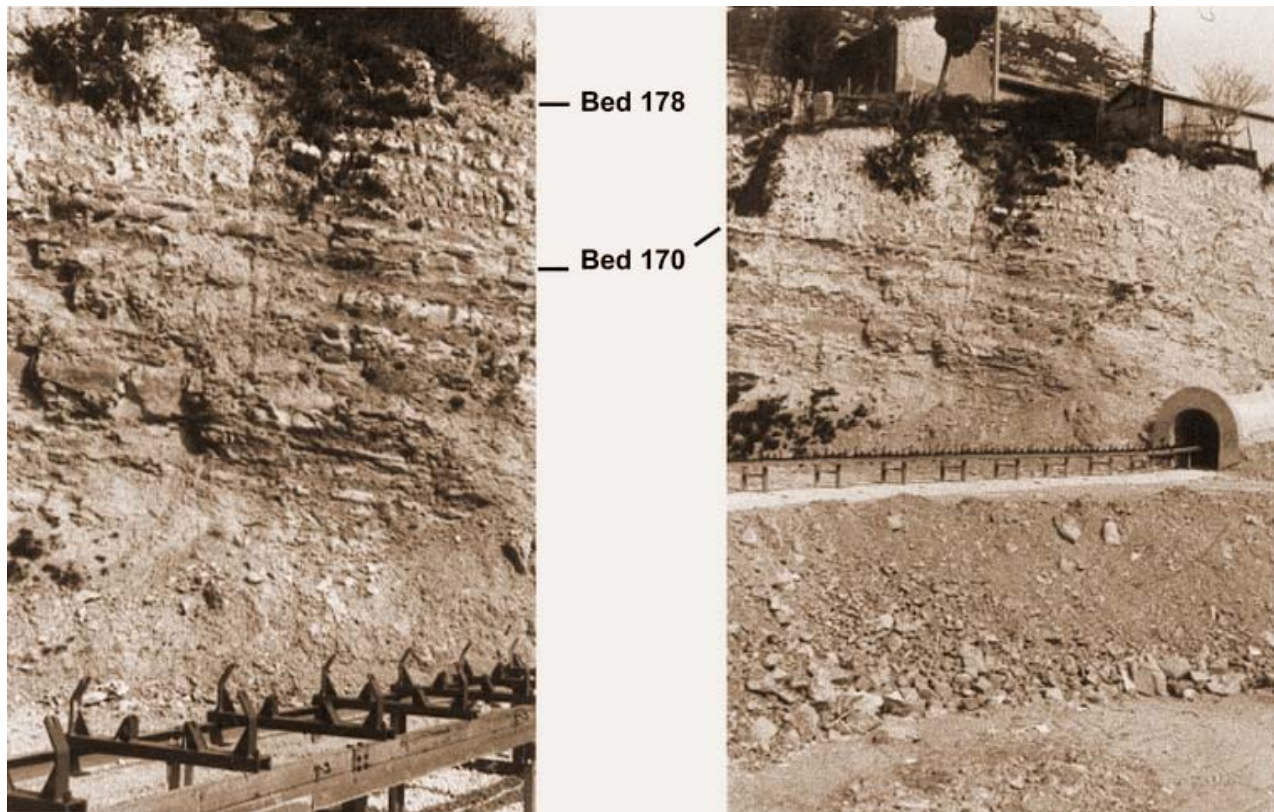
In the middle part (bed 148-160) and the uppermost part (beds 160-169) of the *D. deshayesi* Zone we have segregated two horizons with, respectively, *Roloboceras hambrovi* and *Paradeshayesites grandis* as index-species.

Beds	ZONES	Subzones
178	<i>Dufrenoyia furcata</i>	
170		
169	<i>Deshayesites deshayesi</i>	<i>Paradeshayesites grandis</i>
160		
148		<i>Roloboceras hambrovi</i>
129	<i>Paradeshayesites weissii</i>	
128		
110		
109	<i>Paradeshayesites oganlensis</i> (ex <i>P. tuarkyricus</i> Zone)	
60		<b>BARREMIAN / APTIAN boundary</b>
59	<i>Martelites sarasini</i>	<i>Pseudocrioceras waagenoides</i>
44		
36		

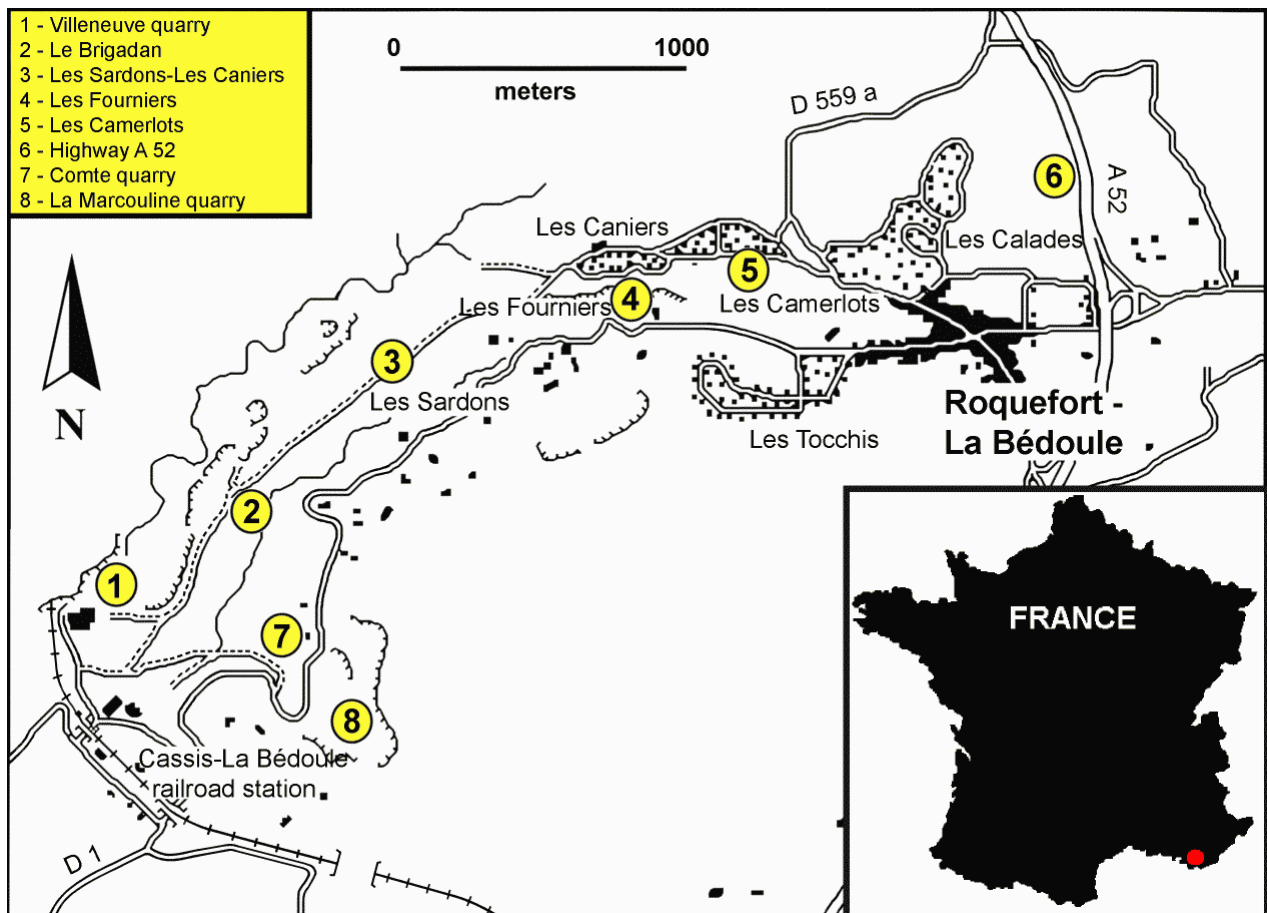
**Figure 2:** Late Barremian /Early Aptian (Bedoulian) biozonation in the stratotypical area of Cassis-La Bédoule - SE France. Bed numbering is that used in MOULLADE *et alii* (2000b).

#### Lower Aptian (Bedoulian) / Middle Aptian (Gargasian) boundary

In the Cassis-La Bédoule area the limit between these two Aptian substages was placed at the bed 170 by FABRE-TAXY *et alii* (1965), mainly because of a significant change between Units 5 and 6 in bedding geometry and rhythm, but also because of the occurrence in bed 170 of a specimen of *Tropaeum bowerbanki*. In 1994 CONTE, having found representatives of *Tropaeum* and *Dufrenoyia* occurring together higher in the succession, proposed moving the boundary up to bed 178. This placement was adopted by MOULLADE *et alii* (1998) and is retained here. Above bed 178 we collected the typical pyritized Gargasian fauna with *Aconeceras nisum*, *Gargasiceras* sp., *Colombiceras* sp., and *Chelonicerases* (*Epicheloniceras*) *martini* (CONTE & ROPOL, in press).



**Figures 3 (a-b):** Uppermost part of the Comte quarry in 1970, and base of the Middle Aptian (above bed 178).



**Figure 4:** Location of the studied sections in the Cassis-La Bédoule area.

## Systematic descriptions

Six sections in the vicinity of Roquefort-La Bédoule (Les Camerlots, Les Caniers, Highway A 52, Les Fourniers) and Cassis (Le Brigadan, Villeneuve-Comte Quarries) (Fig. 4) were investigated for this paper. The Deshayesitidae that we collected are assigned to the *Paradeshayesites oglanlensis*, *P. weissi*, *Deshayesites deshayesi* and *Dufrenoyia furcata* zones.

In the following tables we will use the standard abbreviations generally accepted for the main shell parameters:

D = maximum diameter

d = minimum diameter

Wh = whorl height

Uw = umbilical width

Wb = whorl breadth

(The ratio Wb/Wh expresses the degree of compression of the shell)

K = number of ribs per half whorl

Ph = diameter at the end of phragmocone

n = specimen entirely septate

(E) = Evolute morphotype

(I) = Involute morphotype

All measurement are in mm.

**Material:** Specimens from the ROPOLO Collection are designated by numbers preceded by the mentions "ABR" or "BW". CONTE's collection is labelled with a "C". The material from these two collections is deposited in the Museum of Paleontology, University of Provence, Campus Saint-Charles, Marseilles. The GONNET Collection (Avignon) is labelled "RG".

### Family Deshayesitidae STOYANOW, 1949

We use the generic terms (*Deshayesites*, *Paradeshayesites* and *Dufrenoyia*) as proposed by the Russian authors (BOGDANOVA & MIKHAILOVA, 1999, 2004) in their recent revisions of the family.

#### 1) Genus *Deshayesites* KASANSKY, 1914

Type-species: *Deshayesites deshayesi* LEYMERIE in d'ORBIGNY, 1841, by original designation.

We refer to this genus 16 species collected in the Cassis-La Bédoule area:

- *Deshayesites bedouliensis* CECCA, ROPOLO et GONNET, 1999 (*P. oglanlensis* Zone)
- *D. bogdanovae* AVRAM, 1999 (*P. weissi* Zone)
- *D. consobrinus* (d'ORBIGNY, 1841) (*P. weissi* Zone)
- *D. sp. aff. consobrinus* (d'ORBIGNY, 1841) (*P. oglanlensis* Zone)
- *D. dechyi* PAPP, 1907 (*P. weissi* Zone)
- *D. deshayesi* (LEYMERIE, 1841) (*D. deshayesi* Zone)
- *D. euglyphus* CASEY, 1964 (*P. weissi* Zone)

- *D. evolvens* LUPPOV, 1952 (*P. weissi* Zone)
- *D. forbesi* CASEY, 1961 (*P. weissi* Zone)
- *D. formosus* BOGDANOVA, KVANTALIANI et SHARIKADZE, 1979 (*D. deshayesi* Zone)
- *D. geniculatus* CASEY, 1964 (*D. deshayesi* Zone)
- *D. cf. gracilis* CASEY, 1964 (*P. oglanlensis* Zone)
- *D. luppovi* BOGDANOVA, 1983 (*P. oglanlensis* Zone)
- *D. planus* CASEY, 1964 (*P. weissi* Zone)
- *D. sp. aff. rarecostatus* BOGDANOVA, KVANTALIANI et SHARIKADZE, 1979 (*P. weissi* Zone)
- *D. gr. spathi/normani* CASEY, 1964 (*P. weissi* Zone).

### *Deshayesites bedouliensis* CECCA, ROPOLO et GONNET, 1999 (Pl. 2, figs. 1-2; Pl. 3, figs. 2-3)

- 1999 *Deshayesites bedouliensis* CECCA, ROPOLO et GONNET, p. 270, Pl. 1, fig. 1; Pl. 2, fig. 1; Pl. 3, figs. 1-2; Pl. 4, fig. 1; Pl. 5, figs. 1-2; Pl. 6, fig. 1; Pl. 7, fig. 1; Pl. 8, fig. 1.
- 2000 *Deshayesites bedouliensis* CECCA, ROPOLO et GONNET; CECCA, ROPOLO & GONNET, p. 150-151, Pl. 1 fig. 1.
- 2004 *Deshayesites bedouliensis* CECCA, ROPOLO et GONNET; BOGDANOVA & MIKHAILOVA, p. 202.
- 2004 *Deshayesites bedouliensis* CECCA, ROPOLO et GONNET; VAŠIČEK & SUMMESBERGER, p. 57, Pl. 2, fig. 1.

**Material:** BW 055 (holotype), BW 006, BW 014, BW 021, BW 052, BW 053, BW 054, BW 057, BW 058, BW 061, BW 062, BW 063, BW 067, BW 068, BW 071, BW 074, BW 075, BW112, BW270, RG 1456.

**Description:** Highly variable discoidal shells, with a large umbilicus. Morphotypes may be evolute or involute. On the phragmocone, ornamentation consists first of dense, numerous, thin, flexuous primary, secondary and intercalary ribs, separated by interspaces of equal width, but sculpture becomes increasingly strong on the body chamber where rib relief changes abruptly. There, the ribs become more distant, are bifurcate or often single. Generally, the point of branching is situated on the upper third of the flank. On the internal whorls, primary ribs spring from prominent periumbilical tubercles. On adult specimens, the last whorl usually touches the venter of the preceding one. The section is subtrapezoidal. Some specimens have a rounded venter tending to flatten. The ornamentation of this species has a wide range of variability. The ribs can be rectiradiate, prorsiradiate or rursiradiate. The intercalatories can start at different heights. Sometimes two intercalated ribs are developed rather than one.



**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
Bw 055 (E)	179	52 (0.32)	60 (0.335)	35 (0.195)	~38	113	0.60
Bw 006 (E)	114.5 at 78	53 (0.46) 39 (0.50)	27.5 (0.24) 15 (0.19)	~19 (0.19) ~17 (0.22)	35	n	0.415 0.435
BW 021 (I)	~68 -	- 31	- 17	- -	- ~28	n	-
BW 052 (I)	~110 at 97	- 50 (0.515)	- 17 (0.175)	- -	- 41	n	-
Bw 053 (I)	160 at 114.5	- 55 (0.48)	- 24 (0.21)	- 27 (0.235)	- 44	-	- 0.49
Bw 054 (E)	162	52 (0.32)	58 (0.36)	26.5 (0.16)	35	109	0.51
Bw 057 (I)	~168 at 161 at 131	51.5 (0.31) 50.5 (0.31) 54.5 (0.42)	- 55 (0.34) 32 (0.24)	29 (0.17) 26 (0.16) 25 (0.19)	- -	110	0.56 0.51 0.46
Bw 058 (I)	168 at 120	~57 (0.34) 60.5 (0.50)	54.5 (0.32) 20.5 (0.17)	- -	-	120	-
Bw 061 (E)	~160 at 152	- 52.5 (0.345)	- 46.5 (0.305)	~26 (0.17)	-	112	- 0.495
Bw 062 (I)	~205 at 195 at 144	- 74 (0.38) 67 (0.465)	- ~53 (0.27) 34 (0.24)	- 40 (0.205)	-	144 -	- 0.54
Bw 063 (E)	178 at 122	61.5 (0.345) 59 (0.48)	58 (0.325) 30 (0.245)	~30 (0.17)	38 ~38	~108	0.49
Bw 067 (E)	~165 at 127	48 (0.29) 55 (0.43)	63 (0.38) 37 (0.29)	- 32 (0.25)	36 37	127	- 0.58
Bw 068 (E)	~153.5 at 117	50 (0.235) 49 (0.42)	57.5 (0.37) 34 (0.29)	33 (0.21) 27 (0.23)	33	110	0.60 0.55
Bw 071 (I)	114 at 85	51.5 (0.45) 47.5 (0.56)	24 (0.21) 14 (0.16)	24 (0.21) 21.5 (0.25)	50	111	0.46 0.45
Bw 074 (E)	140 at 105	43.5 (0.31) 51.5	48 (0.34) 24.5 (0.23)	25 (0.18)	32	-	0.57
Bw 075 (I)	131 at 98	66 (0.50) 49 (0.50)	~25 (0.19) 20 (0.20)	- 23 (0.23)	- -	- n	- 0.47
Bw112 (E)	268 -	86 -	~112 -	- 43.3	- -	- 98	- 0.79
Bw270 (I)	112 -	55 -	~24.9 -	- 24	~36 -	-	- 0.503
RG 1456 (E)	225 at 216 at 168	- 71 (0.33) 70 (0.42)	- 80 (0.37) 46 (0.27)	- 45 (0.21)	- ~36 28	~165 -	0.56

**Discussion:** Due its peculiar characteristics: densely ribbed internal whorls and substantial variability in coiling (the whorl-height decreases considerably and the whorl-breadth increases as the umbilicus widens), this taxon cannot be compared with any other occurring in the lowermost Aptian. For example, both *Deshayesites consobrinus* and *Deshayesites* sp. aff. *consobrinus*, have a more rapid growth of the whorls and a different ribbing. The involute specimens of *Deshayesites bedouliensis* in some respects resemble *Paradeshayesites grandis*. But in addition to the fact that the latter occurs at a higher level (*D. deshayesi* Zone, *P. grandis* Subzone), it differs in its stronger ribbing and in the numerous single ribs at the end of the growth. *D. bedouliensis* has also some similarity to the macroconchs of *P. weissii*, but this taxon has more inserted ribs and on the whole is

more densely ribbed.

**Occurrence:** *D. bedouliensis* was described, figured and placed stratigraphically by CECCA *et alii* (1999, 2000). Because individual beds can be correlated in all the sections studied, we have used MOULLADE's bed numbering system (MOULLADE *et alii*, 2000b) to delimit its range. *D. bedouliensis* is the first *Deshayesitidae* encountered at la Bédoule (in beds 60/61 [= bed 82/83 of CECCA *et alii*, 1999] and in beds 62, 65, 69, 75 of MOULLADE's numbering, cf. Fig. 7). *Paradeshayesites oglanlensis* Zone, Le Brigadan, Les Camerlots, Les Caniers, Highway A 52 sections.

**Distribution:** We thought this species endemic, but recently it was found and collected in the lowermost Aptian of the Drôme department, SE France (DELANOY 2005, oral communication) and of Northern Austria. (VAŠIČEK & SUMMESBERGER, 2004).

***Deshayesites bogdanovae* AVRAM, 1999  
(Pl. 10, fig. 7)**

- 1979 *Deshayesites consobrinus* (d'ORBIGNY); BOGDANOVA, Pl. 2, figs. 3a-b & 4a?c.
- 1999 *Deshayesites bogdanovae* AVRAM, p. 452 & p. 455, fig. 8 A-C.

**Material:** 2 specimens: ABR149 and C526.

**Description:** Very similar to the ammonite represented by AVRAM, 1999 (p. 455, fig. 8A), this small evolute discoidal shell has a wide umbilicus, flat sides and dense sigmoidal ribbing. Intercalatories are short, branching at the middle flanks from the neighbouring primary rib. All the ribs are projected onto the ventral area. Section is high-oval with a rounded venter.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR149	32	13.4	11.5	6.5	27	21.5	0.48
C526	47	17	17	-	34	-	-

**Discussion:** The specimens attributed by BOGDANOVA (1979, Pl. 2, figs. 3-4) to *Deshayesites consobrinus* (d'ORBIGNY, 1841) cannot be matched with either the original illustration of d'ORBIGNY (1841) or the lectotype designated by CASEY (1964, p. 352, fig. 124b), which is larger, with coarser ribs, much longer intercalatories and several consecutive primaries. *Deshayesites bogdanovae* AVRAM has a much denser ribbing and no consecutive primaries.

**Occurrence:** *Paradeshayesites weissii* Zone, Les Fourniers, bed 118.

**Distribution:** Lower Aptian (*Paradeshayesites weissii* Zone) of Turkmenistan, Dâmbovicioara Couloir (Romania), SE France.

***Deshayesites consobrinus* (d'ORBIGNY, 1841)****(Pl. 6 , figs. 1 & 6; Pl. 7 , fig. 5)**

- 1841 *Parahoplites consobrinus* d'ORBIGNY, Pl. 47.
- 1915 *Parahoplites weissi* NEUMAYR et UHLIG; KILIAN & REBOUL, Pl. 3, fig. 3.
- 1915 *Parahoplites consobrinus* d'ORBIGNY; KILIAN & REBOUL, Pl. 4, fig. 6.
- non 1979 *Deshayesites consobrinus* (d'ORBIGNY); BOGDANOVA, p. 159-161, Pl. 2, figs. 3a-b (= *D. kemperi* BOGDANOVA et MIKHAILOVA, 2004).
- non 1979 *Deshayesites consobrinus* (d'ORBIGNY); BOGDANOVA, p. 159, Pl. 2 figs. 4a-c [= *D. bogdanovae* AVRAM (1999)].
- 1999 *Deshayesites consobrinus* (d'ORBIGNY); ROPOLO *et alii*, Pl. 19, fig. 1.
- 2000a *Deshayesites consobrinus* (d'ORBIGNY); ROPOLO *et alii*, p. 163, figs. 1-4.
- 2004 *Deshayesites consobrinus* (d'ORBIGNY); BOGDANOVA & MIKHAILOVA, p. 202, Pl. 4, figs. 1-3.

**Material:** 8 complete specimens: RG1571, RG1572, RG1579, RG1580; ABR319, BW076, BW077, SCP4.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
RG1571	228.4	68.5	-	16.44	23	-	0.24
RG1572	141	~58	-	-	22	-	-
RG1579	228.2	72	-	16.80	23	-	0.24
RG1580	210	70	-	-	22	-	-
ABR319	94	41	-	-	22	-	-
BW076	139	~53.5 (0.38)	45 (0.32)	12	23	n	0.22
BW077	135	45.2	47 (0.35)	10	22	~75	0.22
SCP4	255	84	-	18	22	-	0.21

**Description:** Discoidal, compressed shell with each whorl overlapping the upper third of the preceding whorl. The venter is convex, rounded sometimes wide. The flanks are flat or slightly convex. Ribs are first thin, s-shaped and slightly inclined forward. The young whorls show distant, strong, straight or gently flexuous primary ribs that spring from a very slight periumbilical thickening. In the adult whorls, the primary ribs become stronger, sometimes sharp, and prominent particularly in the lower third of the flank where they form slight distinct bullae. Intermediate ribs are often lacking on the body chamber of adult forms. On the venter all the ribs show an adoral convexity. On the last half whorl the number of ribs is from 18 to 20.

**Discussion:** *Ammonites consobrinus* d'ORBIGNY, common in SE France but rare in other regions, was chosen by BUSNARDO (1984) as the index-species of his *Deshayesites consobrinus* Zone. As an index-species *D. consobrinus* could replace *Paradeshayesites weissi*, which is a *nomen dubium* according to CASEY (personal communication, 2000).

In the Les Fourniers and Les Caniers sections we collected several specimens in absolute conformity with d'ORBIGNY's original figure in "*Paléontologie française*" (1841). These specimens were described, placed and illustrated in a preceding paper (ROPOLO *et alii*, 2000a).

**Occurrence:** *Paradeshayesites weissi* Zone, Lower Aptian, La Bédoule, Les Fourniers section; beds 114, 115, 116, 123, 125, 127.

**Distribution:** *Paradeshayesites weissi* Zone, Southern France; *Paradeshayesites weissi* and *D. deshayes?* zones, Tuarkyr, Kubadag, Bolshoi Balkhan, Turkmenistan; *D. forbesi* Zone, *D. fittoni* Subzone; Southern England (under the name *D. cf. consobrinus*); *D. dechyi* Zone, Daghestan, Russia.

***Deshayesites* sp. aff. *consobrinus*  
(d'ORBIGNY, 1841)  
(Pl. 3 , fig. 1)**

- 1973 *Deshayesites* aff. *consobrinus* (d'ORBIGNY, 1841); GLAZUNOVA, p. 134, 135; Pl. 88, figs. 1a-c.
- 1999 *Deshayesites* aff. *consobrinus* (d'ORBIGNY, 1841); CECCA, ROPOLO & GONNET, p. 280, Pl. 9, fig. 1.

**Material:** One complete specimen (BW 066), numerous fragments.

**Description:** This taxon presents many similarities with an ammonite figured by GLAZUNOVA (1973, Pl. 88, figs. 1a-c) collected in the Volga region. Our specimen is an evolute, discoidal shell with an ovate compressed whorl section. On the body chamber, relatively strong, rounded single ribs are separated by an intercalatory which appears, a little above or a little below mid-flank. Then primaries become biplicate on the lower half of the flank. A complete description of this ammonite is given in CECCA *et alii* (1999).

**Measurements:**

specimen	D	Wh	Uw	Wb	K	Ph	Wb/Wh
BW066	200	-	-	-	-	~135	-
(EI)	at 188	68 (0.36)	66 (0.35)	35 (0.19)	30		0.51

**Discussion:** This form differs from *Deshayesites consobrinus* (*sensu stricto*) in its high and steep umbilical wall and more numerous ribs. It differs too from the Turkmenian ammonites described by BOGDANOVA (1979, Pl. 2, figs. 3-4) under the name *Deshayesites consobrinus* (= *Deshayesites bogdanovae* AVRAM, 1999) which bear more flexuous and numerous (27/28) ribs per half-whorl (rather than 22/23) and has a more evolute coiling.

**Occurrence:** *P. ogranlensis* Zone, Le Brigadan, Les Caniers, beds 62, 70, 74, 84.

**Distribution:** Lower Aptian of the Volga



region (Russia), La Bédoule (SE France: *P. oglanlensis* Zone).

***Deshayesites dechyi* (PAPP, 1907)**  
(Pl. 4 , fig. 3; Pl. 5 , fig. 2; Pl. 8, fig. 1)

- 1907 *Parahoplites dechyi* nov. sp., PAPP, p. 171, Pl. 9, figs. 3 & 5 (non 1-2 & 4)
- 1926 *Deshayesites dechyi* (PAPP); RENGARTEN, p. 30, Pl. 2, figs. 11-12; Pl. 9, fig. 6
- 1952 *Deshayesites cf. dechyi* (PAPP); LUPPOV, p. 204, Pl. 7, figs. 1-2
- 1977 *Deshayesites dechyi* (PAPP); BOGDANOVA, p. 50, Pl. 2, figs. 1-5
- 1979 *Deshayesites dechyi* (PAPP); BOGDANOVA, p. 5, Pl. 1, figs. 1-5
- 1999 *Deshayesites dechyi* (PAPP, 1907); BOGDANOVA, Pl. 2, figs. 3-4
- 1999 *Deshayesites dechyi* (PAPP, 1907); BOGDANOVA & PROZOROVSKY, Pl. 4, fig. h.
- 1999 *Deshayesites dechyi* (PAPP, 1907); CONTE, p. 12, fig. 2b.
- 2004 *Deshayesites dechyi* (PAPP, 1907); BOGDANOVA & MIKHAILOVA, p. 203, Pl. 3, figs. 6 & ?8; text-fig. 9.
- 2004 *Deshayesites dechyi* (PAPP, 1907); RAISOSSADAT, p. 129, figs. 4 M-N.

**Material:** 6 specimens: ABR220, ABR14, ABR214, ABR46, ABR502, ABR510, and several fragments.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR220	26.2	12	8.5	-	24	-	-
ABR14	33.4	15.5	14	-	23	-	-
ABR214	38.2	18.5	12	3.5	22	-	0.189
ABR46	42.8	18.2	14.2	-	22	-	-
ABR502	42.8	18	14.8	-	22	-	-
ABR510	64	22	19	13	22	59	0.59

**Description:** Of medium size, with a subrectangular whorl section, *Deshayesites dechyi* is a moderately involute ammonite, with a sigmoidal ribbing that consists of primary and intermediate ribs. Between every two main ribs are intercalated one or two secondary ribs branching between the lower third and the middle of the flank. All ribs are slightly flattened on the venter and form a sinus forward.

**Discussion:** *D. dechyi* presents many similarities in rib pattern with *D. forbesi* CASEY, but that species is more involute and has stronger ribs displayed as a constant alternation of primary and intercalatory ribs.

**Occurrence:** *Paradeshayesites weissi* Zone, Lower Aptian, *Deshayesites deshayesi* Zone, Cassis-La Bédoule: beds 125, 127 of Les Fourniers section, bed 138c of Comte quarry section.

**Distribution:** Lower Aptian, *D. dechyi/deshayesi* Zone of North Caucasus, Dagestan (Russia) and Romania; *D. weissi/D.*

*deshayesi* Zone of Turkmenistan and SE France; Lower Aptian ("plita") of Mangyshlak (Kazakhstan); Lower Aptian of Kopet Dag Basin (Iran).

***Deshayesites cf. dechyi* (PAPP, 1907)**  
(Pl. 7 , fig. 3)

**Material:** One complete specimen (ABR501), one fragment (C003) and one incomplete specimen (C033).

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR501	38	16	11	-	20	-	-
C013	42.5	15.8	10.5	-	20	-	-

**Description:** Of medium size, this ammonite is more involute than *Deshayesites dechyi* and has sigmoidal bifurcate and trifurcate ribs branching at the mid-flank. As in *D. deshayesi*, the primary ribs start from the umbilical wall but become stronger on the siphonal area. The umbilical width is about a quarter of the total diameter.

**Discussion:** Ribs are as strong as in *Deshayesites euglyphus* CASEY, but less regular and are not bent forward in a shallow arc on the venter. The poor preservation of our specimen does not permit a better comparison of this form with the typical *Deshayesites dechyi*.

**Occurrence:** Beds 137, 138c, *D. deshayesi* Zone, Les Fourniers section.

***Deshayesites deshayesi* (LEYMERIE, 1841)**  
(Pl. 10 , figs. 1-2)

- 1841 *Ammonites Deshayesi* LEYMERIE; d'ORBIGNY, Pl. 85, figs. 1-4.
- 1907 *Hoplites (Parahoplites) Deshayesi* LEYMERIE; JACOB, p. 46, fig. 28.
- 1938 *Parahoplites (Parahoplitoides) deshayesi* LEYMERIE; ROMAN, p. 350, fig. 326.
- 1957 *Deshayesites deshayesi* (LEYMERIE); WRIGHT, p. L 387, fig. 505.
- 1964 *Deshayesites deshayesi* (LEYMERIE); CASEY, p. 295, Pl. 43, fig. 3; text-fig. 106.
- 1973 *Deshayesites deshayesi* (LEYMERIE); GLAZUNOVA, p. 120, Pl. 76, fig. 1.
- 1977 *Deshayesites deshayesi* (LEYMERIE); BOGDANOVA, p. 55, Pl. 3, fig. 6.
- 1979 *Deshayesites deshayesi* (LEYMERIE); BOGDANOVA, Pl. 2, fig. 6.
- 1999 *Deshayesites deshayesi* (LEYMERIE); BOGDANOVA & PROZOROVSKY, p. 78, Pl. 7, figs. b & e-f.
- 2004 *Deshayesites deshayesi* (LEYMERIE); BOGDANOVA & MIKHAILOVA, Pl. 4, figs. 6-7.
- 2004 *Deshayesites deshayesi* (LEYMERIE); RAISOSSADAT, p. 130, figs. 5 D-E & H-I.

**Material:** 2 complete specimens: ABR511, ABR512, and several fragments

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR511	37	18.8	9.8	-	22	-	-
ABR512	50	22	15.2	-	24	38.2	-

**Description:** Shells of medium size with nearly parallel sides and a slightly flattened venter. Although somewhat crushed, our specimens conform to the figuration of CASEY (1964, text-fig. 106) with sigmoidal, sharp and strong ribs. Primary ribs start from the upper part of the umbilical wall and are directed forward forming a gentle sigmoidal curve. Intermediate ribs are intercalated between main ribs. Between each pair of primaries, there is only one secondary, branching between the mid-flank and the outer third.

**Discussion:** *Deshayesites deshayesi* (LEYMERIE) presents some similarities with *D. forbesi* CASEY, in the regular alternation of long and short ribs. But *D. forbesi* is generally evolute, the ribbing is denser and more regular, the umbilical wall is oblique, and the sides are more rounded.

**Occurrence:** Beds 129a & b, 135, 150 of Comte Quarry section, *D. deshayesi* Zone.

**Distribution:** Lower Aptian (*D. deshayesi* Zone) of England, North Germany, Bulgaria, SE France (La Bédoule), Turkmenistan; Lower Aptian of Daghestan (Russia), Mangyshlak (Kazakhstan), Kopet Dag (NE Iran).

***Deshayesites euglyphus* CASEY, 1964**  
(Pl. 5 , fig. 5; Pl. 6 , fig. 7)

- 1964 *Deshayesites euglyphus* CASEY, p. 336-338; Pl. 52, figs. 1-4; Pl. 56, figs. 1 a-b.
- 1999 *Deshayesites euglyphus* CASEY; BOGDANOVA, Pl. 2, fig. 7.
- 1999 *Deshayesites euglyphus* CASEY; BOGDANOVA and PROZOROVSKY, Pl. 4, figs. a, d & f.

**Material:** 2 specimens: ABR490, ABR500.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR490	45	19.5	15.2	7	22	38.2	0.358
ABR500	26	12	12.2	6	20	-	0.5

**Description:** Ammonite moderately evolute, with a subrectangular whorl section; flanks slightly rounded. The ribbing, very regular, consists of strong, sigmoidal, rounded primary ribs starting from the umbilical wall and intercalated secondary ribs branching from a little below to a little above mid flank.

**Discussion:** As noted by CASEY (1964), the inner whorls, uniformly costate, are similar to those of *Deshayesites kiliani* SPATH, 1930. But the umbilicus is wider and there are fewer secondary ribs. Variability is very high in this

species and in private collections we have observed many forms transitional between *D. kiliani* and *D. gr. spathil/normani*, which also present certain characters of *Deshayesites euglyphus*.

**Occurrence:** Beds 112, 120 Les Fourniers section, *P. weissii* Zone.

**Distribution:** *D. forbesi* Zone of England; *D. weissii* Zone, Turkmenistan; Lower Aptian ("plita") of Mangyshlak (Kazakhstan), Iran, SE France.

***Deshayesites evolvens* LUPPOV, 1952**  
(Pl. 5 , fig. 4; Pl. 8, fig. 2)

- 1952 *Deshayesites evolvens* nov. sp. LUPPOV, p. 205, Pl. 8, fig. 1.
- 1967 *Deshayesites evolvens* LUPPOV; DIMITROVA, p. 184, Pl. 91, fig. 1.
- 1995 *Deshayesites* aff. *evolvens* LUPPOV; DELANOY, Pl. 3, fig. 1.
- 1999 *Deshayesites evolvens* LUPPOV; ROPOLO *et alii*, Pl. 19, fig. 3.
- 1999 *Deshayesites* cf. *evolvens* LUPPOV; CONTE, p. 13, figs. 3a-b.

**Material:** 2 specimens: PR/Abm311 (mould), ABR489 (incomplete specimen); RG1577 (this one slightly crushed).

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
PR/Abm311	242	72 (d=200)	90	30.5 (d=150)	20	145	0.55 (d=150)
RG1577	77	35.1	20	-	22	n	-

**Description:** Discoidal ammonite with flat or slightly convex flanks. On the inner whorl ornamentation consists of relatively strong and flexuous ribs, proverse forward and starting from the inside of the umbilical wall. These ribs (24 by half whorl) are bifurcate, or more rarely, trifurcate at mid-flank. On the body chamber the ribbing changes. Ribs become stronger, straight and simple. Intermediate ribs disappear progressively and only single, distant ribs subsist by the aperture. Our specimens correspond to LUPPOV's original illustration (1952, Pl. 8, fig. 1).

**Discussion:** This species presents many affinities with an ammonite figured by KILIAN & REBOUL (1915, Pl. 3, fig. 3) under the name *Parahoplites weissii* (NEUMAYR et UHLIG) which, according to LUPPOV (1952), must be referred to *Deshayesites evolvens*.

**Occurrence:** Les Fourniers section, beds 115, 119, *P. weissii* Zone.

**Distribution:** Lower Aptian of Turkmenistan (*Deshayesites* Zone in LUPPOV, 1952); Lower Aptian of Bulgaria, NE Caucasus (Russia) and Mangyshlak (Kazakhstan); *P. weissii* Zone in SE France.

***Deshayesites forbesi* CASEY, 1961**  
(Pl. 6, figs. 2-4; Pl. 7, fig. 4)

- 1961 *Deshayesites forbesi* CASEY, p. 593, Pl. 81, figs. 2a-b.
- 1964 *Deshayesites forbesi* CASEY; CASEY, p. 314, Pl. 47, figs. 1a-b & 2-7; text-figs. 104g, 106i & 110a.
- 1999 *Deshayesites forbesi* CASEY; AVRAM, p. 449, figs. 6 F-H.
- 2004 *Deshayesites forbesi* CASEY; BOGDANOVA & MIKHAILOVA, Pl. 3, fig. 4.

**Material:** Two fragments ABR42a & b, and 3 incomplete specimens: ABR47, ABR318, ABR333.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR47	45	22	16	-	34	n	-
ABR318	101	41	33	-	~30	n	-
ABR333	49	20	15	-	~30	n	-

**Description:** Our specimens are assigned to CASEY's species, because of their oblique umbilical wall and similar ornamentation. Ribbing consists of bifurcate slightly sinusoidal primary ribs branching at the lower third of the flank. All the ribs project forward on the venter.

**Discussion:** This species presents a high degree of variability so four varieties were formally named by CASEY (1964): *Deshayesites forbesi forbesi*, *D. forbesi* var. *koenini*, *D. forbesi* var. *flexuosus*, *D. forbesi* var. *crassicosatus* and, according to the author (1964, p. 319), there are many other transitional forms related to the typical one.

**Occurrence:** Beds 117, 126, Comte Quarry section.

**Distribution:** *D. forbesi* Zone of England, *P. weissii* Zone in SE France, *D. deshayesi* Zone of Bulgaria.

***Deshayesites formosus* BOGDANOVA, KVANTALIANI et SHARIKADZE, 1979**

- 1979 *D. formosus* BOGDANOVA, KVANTALIANI et SHARIKADZE; Pl. 4, figs. 1-6.
- 1999 *D. formosus* BOGDANOVA, KVANTALIANI et SHARIKADZE; BOGDANOVA & MIKHAILOVA, p. 526.

**Material:** One specimen (ABR503).

**Measurements:**

specimen	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR503	33	10	12.2	-	~20	-	-

**Description:** Evolute ammonite with flat and sub-parallel sides. On the inner whorls ribs are sinusoidal with secondaries branching at mid-flank. In early whorls one or two intermediate ribs alternate regularly with primaries branching from them at the first third of the flank. On the body chamber, ribs can be

single and become stronger and more widely spaced with growth.

**Discussion:** *D. formosus* presents some similarities with *D. consobrinus* but differs from it by having more bifurcations on the ribs which biplicate or sometimes triplicate on the main whorls.

**Occurrence:** Bed 120, *P. weissii* Zone, Comte quarry section.

**Distribution:** *D. dechyi*-*D. deshayesi* Zone of Daghestan (Russia), *P. weissii* Zone in SE France.

***Deshayesites geniculatus* CASEY, 1964**  
(Pl. 10, fig. 6)

- 1961 *Deshayesites* sp. nov. CASEY, p. 510, p. 609.
- 1964 *Deshayesites geniculatus* sp. nov., CASEY, p. 307, Pl. 46, figs. 5a-b; Pl. 51, figs. 9a-b.
- 1999 *Deshayesites geniculatus* CASEY; BOGDANOVA & MIKHAILOVA, p. 526.

**Material:** One incomplete specimen (ABR508).

**Measurements:**

specimen	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR508	63	26	18.5	-	~20	-	-

**Description:** Evolute ammonite with a high rounded subrectangular whorl section. Ribs are strong, flexuous, prorsiradiate, primaries rising from the mid-height of the umbilical wall. There are one, sometimes two, intercalatories branched from the neighbouring primary rib. Some intercalatory ribs appear at the upper third of the flank. About 20 ribs per half whorl.

**Discussion:** Our specimen clearly resembles that figured by CASEY (1964, Pl. 46, fig. 5a). But its ribbing is less regular and ribs seem more numerous. It shows some similarities with *Deshayesites punfieldensis* SPATH, but in that species ribs curve more strongly and the interval between two ribs is larger.

**Occurrence:** Bed 166, Comte Quarry section, *D. deshayesi* Zone (*P. grandis* Subzone).

**Distribution:** *D. deshayesi* Zone (*P. grandis* Subzone) of southern England; *D. deshayesi* Zone (*P. grandis* Sub-Zone) of SE France.

***Deshayesites* cf. *gracilis* CASEY, 1964**  
(Pl. 10, fig. 4)

- 1964 *Deshayesites gracilis* sp. nov., CASEY, p. 324, Pl. 47, fig. 10.
- 2004 *Deshayesites gracilis* CASEY; BOGDANOVA & MIKHAILOVA, p. 207, Pl. 6 figs. 5-6; text-fig. 13.

**Material:** One specimen (ABR336).

**Measurements:**

specimen	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR336	51	20	13.5	-	~30	-	-

**Description:** Shell moderately involute, with flat sides. The umbilical area occupies one third of the diameter and bears tubercles. Ribs are narrow, weakly sigmoidal and inclined forward (about 30 per half whorl). The main ribs start from the upper part of the umbilical wall. One or two secondary ribs are intercalated between each pair of main ribs starting at the inner third of the flank.

**Discussion:** Our specimen shows a denser ribbing than that of the typical form. It presents some similarities with *D. involutus* var. *hytensis* CASEY, but this variety has a narrower umbilicus and shorter secondary ribs, starting just above mid-flank, some of them fusing with adjacent main ribs. It can also be confused with *D. callidiscus* CASEY but the ribbing of this taxon is denser and flexuosity of its ribs is more accentuated.

**Occurrence:** Bed 159, Comte Quarry section, *D. deshayesi* Zone (*R. hambrovi* Subzone).

**Distribution:** Lower Aptian (Crackers Beds) of South England; *P. weissii* Zone of Turkmenistan; *D. deshayesi* Zone of Bulgaria, SE France.

***Deshayesites luppovi* BOGDANOVA, 1983  
(Pl. 1, figs. 1-2, 4 & 12)**

- 1952 *Deshayesites* aff. *dechyii* PAPP; LUPPOV, p. 203, Pl. 7, fig. 1.
- 1983 *Deshayesites luppovi* BOGDANOVA, p. 139, Pl. 3, figs. 1-6
- 1999 *Deshayesites luppovi* BOGDANOVA; AVRAM, p. 447, figs. 5 f-g.
- 1999 *Deshayesites luppovi* BOGDANOVA; BOGDANOVA, Pl. 1, fig. 10.
- 1999 *Deshayesites luppovi* BOGDANOVA; BOGDANOVA & PROZOROVSKY, Pl. 3, fig. f.
- 1999 *Deshayesites luppovi* BOGDANOVA; ROPOLLO *et alii*, p. 178, Pl. 16, figs. 4-5.
- 2004 *Deshayesites luppovi* BOGDANOVA; RAISOSSADAT, p. 125, Figs. 5 A, C & L.
- 2004 *Deshayesites luppovi* BOGDANOVA; BOGDANOVA & MIKHAILOVA; p. 207, Pl. 2, figs. 8-9; text-fig. 14.

**Material:** 12 specimens: ABR32, ABR36, ABR279, ABR285, ABR2168, ABR2169, ABR2172, ABR2173, ABR2174, ABR2177, ABR1285, ABR4601.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR32	45.2	20.2	15	4	30	37	0.198
ABR36	~82	34	25	-	~33	~19	-
ABR279	~42	16	12.5	-	~28	28	-
ABR285	~51	20	19.5	-	~28	44	-
ABR2168	~82	34	25	-	33	~19	-
ABR2169	~39	18	13	-	~28	~18	-
ABR2172	~35	14.5	13	-	30	~18	-
ABR2173	28	13	10	-	28	n	-
ABR2174	~26	11	7	-	28	~18	-
ABR2177	~26	10.5	9	-	27	~20	-
ABR1285	~37	14	12	-	~30	~16	-
ABR4061	~18.6	8	6.2	-	~27	~19	-

**Description:** Small, moderately involute shells, with nearly flat flanks, narrow and rounded venter. Umbilicus is about one third of the diameter. The ribbing is very sinuous with sigmoidal primaries arched forward near the middle part of the flanks; one or two secondaries frequently bifurcate or trifurcate from primaries. Secondaries are variable in length; the point of union with primaries may be well above mid-flank (bifurcate ribs), or well below (trifurcate ribs). Sometimes primaries form peri-umbilical bullae and broaden out strongly before branching.

**Discussion:** Our specimens are comparable in rib pattern and umbilicus width with those figured by BOGDANOVA & MIKHAILOVA (2004, figs. 8-9). The coiling of *D. luppovi* is slightly more evolute than that of *Paradeshayesites oglanlensis*; ribs are stronger and more flexuous.

**Occurrence:** *P. oglanlensis* Zone, beds 61, 63, 65, 72, 78, 88, 101. Le Brigadan, Les Caniers, Highway A52, Les Camerlotts sections.

**Distribution:** *Paradeshayesites tuarkyricus* and *P. weissii* zones of Turkmenistan; *P. oglanlensis* Zone of SE France, Spain, Romania; Lower Aptian ("**plita**") of Mangyschlak (Kazakhstan), Iran.

***Deshayesites* sp. aff. *luppovi*  
BOGDANOVA, 1983  
(Pl. 4, fig. 1)**

**Material:** One complete specimen (ABR279).

**Measurements:**

specimen	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR279	184.6	65.5	66	41 at d=184.6 26 at d=155	~20	134	0.625

**Description:** Large involute shell, moderately evolute on the last whorl, with flat or slightly convex flanks, narrow and rounded venter, numerous and sinuous ribs on the juvenil whorls, starting as a kind of tubercle on the umbilical wall. The primary ribs are separated by one or two secondary ribs either

branching on mid-flank or single. On the body chamber, all ribs become stronger, prominent, and intercalatory often separated from the neighbouring primary rib. All ribs cross the venter without interruption and show a gentle adoral convexity.

**Discussion:** Because of the great similarity of the ribbing pattern with *Deshayesites luppovi*, we think that this specimen could be a macroconch of this species. The distant and strong ribbing on the last whorl and the high and steep umbilical wall on the body chamber separate this specimen from those included in *D. bedouliensis*, which is characterized by a finer and weaker ribbing.

**Occurrence:** Bed 72, Le Brigadan Section (*P. oglanlensis* Zone).

***Deshayesites planus* CASEY, 1964  
(Pl. 5, fig. 3)**

- 1961 *Deshayesites planus* CASEY, p. 609.
- 1964 *Deshayesites planus* CASEY, p. 323, Pl. 57, fig. 5; text-figs. 112a-b & e.
- 1977 *Deshayesites planus* CASEY; BOGDANOVA, p. 52, Pl. 3, figs. 1-5; Pl. 4, figs. 7-8; text-figs. 4a-b.
- 1999 *Deshayesites planus* CASEY; AVRAM, p. 445, figs. 5c-e.
- 1999 *Deshayesites planus* CASEY; BOGDANOVA & PROZOROVSKY, Pl. 4, figs. g & ?i.

**Material:** Two complete specimens: ABR321, ABR339, and several fragments of spire.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR321	20	9	6	-	~28	-	-
ABR339	31	19	8.5	-	~28	-	-

**Description:** Small moderately evolute shell with flat sides. Our specimens are conformable with the holotype figured by CASEY (1964, Pl. 57, fig. 5). Primary ribs start from the upper part of the umbilical wall. At mid-flank, these main ribs biplicate or triplicate in short secondary ribs intercalated between two primaries. All ribs form a sigmoidal curve on the flanks.

**Discussion:** We found many fragments of this species in the *weissi* Zone but only two specimens were complete. The umbilicus seems to be larger than that of CASEY's type.

**Occurrence:** Bed 116, Comte Quarry section, *P. weissii* Zone.

**Distribution:** *D. forbesi* Zone of England (*callidiscus* Subzone), *P. weissii* Zone of Turkmenistan and SE France, Lower Aptian of Bulgaria.

***Deshayesites* cf. *planus* CASEY, 1964  
(Pl. 9, fig. 3)**

**Material:** One specimen ABR362.

**Measurements:**

specimen	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR362	64	29	14	-	34	-	-

**Description:** Involute crushed ammonite, with a ribbing pattern similar to that of *Deshayesites planus* but the ribs are more numerous and more flexuous. On the umbilical wall the main ribs start forming a kind of bundle. At mid-flank, they become very sinuous and bifurcate or trifurcate. About 34 ribs by half whorl. Umbilicus very narrow.

**Discussion:** This ammonite differs from *Deshayesites* cf. *planus* described and illustrated by RAISOSSADAT (2004, p. 130, figs. 5 J-K) by a less regular, denser and more sinuous ribbing. Intermediate ribs start commonly from the upper third of the flank.

**Occurrence:** Bed 122, Les Fourniers Section, *P. weissii* Zone.

**Distribution:** *P. weissii* Zone of SE France.

***Deshayesites* sp. aff. *rarecostatus*  
BOGDANOVA, KVANTALIANI et SHARIKADZE,  
1979**

- 1979 *Deshayesites rarecostatus* BOGDANOVA, KVANTALIANI et SHARIKADZE, p. 526, Pl. 3, figs. 1-4.

**Material:** A fragment of whorl; specimen C031.

**Description:** The fragment mentioned above is half a whorl of an evolute shell of about 45 mm diameter. The ribs are exceptionally strong (about 22 by half whorl), biplicate and spring from the upper part of the umbilical wall, with their point of branching located just below or just above mid-flank. Sometimes intercalate ribs are single.

**Discussion:** Because its sculpture corresponds to that of the specimens illustrated in BOGDANOVA *et alii* (1979, Pl. 3, figs. 1-4), we relate with doubt this fragment to *D. rarecostatus*. However, more and better preserved material is needed to clarify the taxonomic status of this form.

**Occurrence:** Bed 137, Comte Quarry section, *P. deshayesi* Zone.

**Distribution:** *Deshayesites dechyii/deshayesi* Zone of Daghestan; *D. deshayesi* Zone of SE France (La Bédoule).



***Deshayesites* sp. gr. *spathi* CASEY,  
1964/*normani* CASEY, 1964  
(Pl. 5, fig. 1; Pl. 8, fig. 3; Pl. 9, fig. 1)**

- 1930 *Deshayesites* SPATH, p. 430.
- 1964 *Deshayesites spathi*, CASEY, p. 332, Pl. LI, fig. 2; Pl. LII, figs. 5a-b & 6; text-figs. 116e & 117.
- cf. 1964 *Deshayesites normani*, CASEY, p. 344, text-fig. 121; Pl. 50, fig. 7; Pl. 54, figs. 1a-b; Pl. 55, figs. 3-4; Pl. 56, figs. 3a-b.
- 1995 *Deshayesites* gr. *spathi/normani* CASEY; DELANOY, p. 82, Pl. 1 fig. 2.
- 1999 *Deshayesites spathi* CASEY; ROPOLO *et alii*, Pl. 18, fig. 4.
- 2000 *Deshayesites* aff. *normani* CASEY; GONNET *et alii*, Pl. 2, fig. 5; Pl. 7, fig. 2

**Material:** Two well preserved specimens and a very large ammonite with sculpture only partly visible: ABR323, ABR340; ABG342.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR323	165.6	~58	48.8 (d=144)	37.2 (d=144)	24	126	0.258
ABR340	83	32.8	32.6	-	26	59	-
ABG342	193	64 (d=180.8)	69 (d=180.8)	42	21	-	-

**Description:** This species has a rounded venter and a thick robust ribbing. Primaries, first prominent and then spatulate, start from the umbilical margin and bifurcate or trifurcate at the inner third of the flank but sometimes remain single on the body chamber in adult specimens (ABG342). All ribs form a feebly sigmoidal curve at mid-flank and become thinner on the upper part of the side. Secondaries are irregularly intercalated between main ribs.

**Discussion:** *Deshayesites spathi* CASEY, 1964 and *D. normani* CASEY, 1964, both common ammonites of the *D. forbesi* Zone in England, have a "similar type of ribbing" (CASEY 1964, p. 345); so it is often difficult to distinguish between them and they are often confused. As they occur in the same levels we are led to think that these two forms could be morphologic variants of a single species. This seems to be the opinion of Russian authors too because in the "species composition" of the genus *Deshayesites* in BOGDANOVA & MIKHAILOVA, 1999 (p. 523-526), *D. spathi* is not mentioned.

**Occurrence:** Beds 111, 114, 126, Les Fourniers section, *P. weissii* Zone.

**Distribution:** *D. forbesi* Zone of England; *P. weissii* Zone of SE France (La Bédoule) and Turkmenistan.

**2) Genus: *Paradeshayesites* KEMPER, 1967**

Type-species: *Hoplites laeviusculus* KOENEN, 1902; Lower Aptian, *tenuicostatus* Zone, Northern Germany.

We include in this genus 7 species collected in the several sections studied at Cassis-La Bédoule:

- *Paradeshayesites callidiscus* var. *rugosus* (CASEY, 1961),
- *Paradeshayesites grandis* (SPATH, 1930),
- *Paradeshayesites* cf. *involutus* (SPATH, 1930),
- *Paradeshayesites oganlensis* (BOGDANOVA, 1983),
- *Paradeshayesites planicostatus* (BOGDANOVA, 1991),
- *Paradeshayesites weissii* (NEUMAYR et UHLIG, 1881),
- *Paradeshayesites weissiformis* (BOGDANOVA, 1983).

***Paradeshayesites callidiscus* CASEY  
1961, var. *rugosus* CASEY 1964  
(Pl. 4, fig. 2; Pl. 7, fig. 1)**

- 1964 *Deshayesites callidiscus* CASEY, var. *rugosus* nov., CASEY, p. 329, Pl. 49, figs. 5a-b; Pl. 56, figs. 5a-b.
- 1999 *Deshayesites callidiscus* CASEY; ROPOLO *et alii*, Pl. 19, fig. 2.
- 2000 *Deshayesites callidiscus* CASEY; GONNET *et alii*, Pl. 6, fig. 3.

**Material:** ABR43, ABR188, ABR317, ABR388, ABR337; RG1576. Numerous fragments.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR43	123.8	58	32.2	14	26	90.2	0.241
ABR188	112	52	25	32	28	81	0.615
ABR317	65	28	21	-	26	45	-
ABR388	52	26.2	13	17	26	~37	-
RG1576	47	22	13.5	-	26	-	-
ABR337	32	15	8.5	-	26	-	-

**Description:** This taxon is well represented in the *P. weissii* Zone of the Cassis-La Bédoule area. Shells of medium to large size, with flat sides, venter rounded and weakly convex. Some specimens are compressed (ABR43). The umbilical width is about one quarter of the diameter. 26 sigmoidal ribs per half-whorl. Sigmoidal primaries start from the umbilical wall, first thin on the first third of flank, then becoming stronger and flat topped. They bifurcate at mid-flank, where short intercalatories are inserted. All ribs are separated by very narrow interspaces and cross the venter, forming a sinus towards the aperture.

**Discussion:** We refer our specimens to *Deshayesites callidiscus* CASEY, var. *rugosus* CASEY because their ornamentation somewhat resembles that of the ammonite illustrated by the author (Pl. 56, figs. 5a-b). They differ slightly from the typical forms which have more numerous and more flexuous ribs and a "fasciculate" type of ribbing.

**Occurrence:** Beds 110, 113, 119, Les Fourniers section, *P. weissii* Zone.

**Distribution:** *D. forbesi* Zone of England; *P. weissii* Zone of SE France (La Bédoule)

***Paradeshayesites grandis* (SPATH, 1930)  
(Pl. 10, figs. 3 & 5; Pl. 11, fig. 1)**

- 1930 *Deshayesites grandis* SPATH; pp. 427-9 (pars), Pl. 17, figs. 2a-b.
- 1964 *Deshayesites grandis* SPATH; CASEY, p. 308-310, Pl. XLIII, figs. 1a-b; Pl. XLIV, figs. 1-3; Pl. LI, figs. 7a-b; text-fig. 110c.

**Material:** 5 specimens: ABR360, ABR347, ABR348, ABR352, ABR354, and many fragments.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR360	27.2	14	9	-	26	-	-
ABR347	31	15	9.5	-	28	-	-
ABR348	~85	~42	25 (d=82)	~13	28	-	0.309
ABR352	149	71	38	-	26	-	-
ABR354	169	72.8	45	39	28	128	-

**Description:** Highly variable ammonite with more or less involute shells. CASEY (1964) figured large specimens of *Deshayesites grandis* which are either evolute (Pl. XLIII, figs. 1a-b) or involute (Pl. XLIV, figs. 1-2). The sculpture consists of gently flexuous or straight ribs starting from the vertical umbilical wall and intercalatories branching at mid-flank. Some primaries bifurcate or trifurcate on the first third of the side. Interspaces are very narrow. The ribbing is generally strong and there are sometimes numerous single ribs at the end of the growth. Sides are flat or gently convex. The poor preservation of our specimens, which are incomplete or cannot be extracted from the gangue, does not permit a more exact study of the shell section.

**Discussion:** Our specimens range in diameter from 27,2 (microconch?) to 169 (macroconch ?) mm. To a degree several fragments resemble extreme forms of *Dufrenoyia* gr. *truncata/discoidalis* CASEY or *Dufrenoyia transitoria* CASEY. However, *Paradeshayesites grandis* has denser ribbing and a well rounded venter, while in *Dufrenoyia* the ribs form nodes or ventrolateral shoulders on the venter which is always narrow and flattened.

**Occurrence:** Beds 161a, 164, 166, Comte Quarry section, *D. deshayesi* Zone, *P. grandis* Subzone.

**Distribution:** *D. deshayesi* Zone, *P. grandis* Subzone of England, Cassis-La Bédoule (SE France).

***Paradeshayesites cf. involutus* (SPATH, 1930)  
(Pl. 9, fig. 2; Pl. 12, fig. 1)**

- cf. 1930 *Deshayesites consobrinus* (d'ORBIGNY) var. *involuta* SPATH, p. 432.
- cf. 1964 *Deshayesites involutus* SPATH; CASEY, p. 310, Pl. 45, figs. 1a-c; text-fig. 107.
- 1964 *Deshayesites cf. involutus* SPATH; CASEY, p. 310, Pl. 45, figs. 4a-b.
- 1999 *Deshayesites cf. involutus* SPATH; AVRAM, p. 454, fig. 8d.
- 2004 *Deshayesites cf. involutus* (SPATH); RAISOSSADAT, p. 129, figs. 6A-C.

**Material:** Two specimens (a small incomplete juvenile specimen and a large adult shell with poorly preserved sculpture): ABG325, ABG329, and numerous fragments.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABG325	47	20	16	-	26	-	-
ABG329	185	62 (d=172)	52.2 (d=172)	-	~24	-	-

**Description:** Moderately involute ammonites with a wide umbilicus (about one-third of the diameter), vertical umbilical wall and rounded venter. Ornamentation consists of straight primary ribs and short secondaries often irregularly branched on main ribs at mid-flank or on the upper part of the side. Some intercalatories are single, others bifurcate or trifurcate. Ribs can be radial on the body chamber or weakly sigmoidal.

**Discussion:** Our juvenile specimen shows similarities in the rib pattern with *Paradeshayesites cf. involutus* (SPATH) illustrated by CASEY (1964, Pl. 45, figs. 4a-b). The adult specimen could be confused with the Lower Bedoulian species *Deshayesites consobrinus*, but its umbilicus is wider than that of the d'ORBIGNY's species and this specimen was collected in the Upper Bedoulian *P. grandis* Sub-Zone, with two fragments of the same species.

**Occurrence:** Beds 165, 168. Comte Quarry section, *D. deshayesi* Zone, *P. grandis* Subzone.

**Distribution:** *D. deshayesi* Zone, *P. grandis* Subzone of England, Cassis-La Bédoule (SE France).

***Paradeshayesites oglanlensis* (BOGDANOVA, 1979)  
(Pl. 1, figs. 3, 11 & 13)**

- 1979 *Deshayesites oglanlensis* BOGDANOVA; p. 153, Pl. 2, figs. 5a-5b [nomen nudum].
- 1983 *Deshayesites oglanlensis* BOGDANOVA; p. 136, Pl. 1, figs. 5-9; text-figs. 5-6.
- 1995 *Deshayesites oglanlensis* BOGDANOVA; DELANOY, p. 74, Pl. 2, figs. 1 a-b.
- 1997 *Deshayesites oglanlensis* BOGDANOVA;

AGUADO *et alii*, fig. 7 e.

- 1999 *Deshayesites oglanlensis* BOGDANOVA; ROPOLLO *et alii*, p. 278, Pl. 17, fig. 2 (non fig. 1).
- 1999 *Deshayesites oglanlensis* BOGDANOVA; BOGDANOVA & PROZOROVSKY, Pl. 3, figs. d-e.
- 1999 *Deshayesites oglanlensis* BOGDANOVA; CECCA *et alii*, p. 278, Pl. 1, figs. 2-4.
- 2000 *Deshayesites oglanlensis* BOGDANOVA; GONNET *et alii*, Pl. 1, fig. 2; Pl. 2, fig. 4 (non Pl. 1, fig. 1).
- 2004 *Deshayesites oglanlensis* BOGDANOVA; RAISOSSADAT, p. 123, Pl. 4, figs. G-H.
- 2004 *Paradeshayesites oglanlensis* (BOGDANOVA); BOGDANOVA & MIKHAILOVA, p. 214, Pl. 7, fig. 4

**Material:** 9 specimens: BW002, BW004, BW007, BW011a, BW021, BW050, ABR271, ABR281, ABR30.

#### Measurements:

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
BW002	~40	16 (0.40)	10.5 (0.26)	-	~33	~19	-
BW004	~34	11.5 (0.34)	8 (0.235)	-	28	~18	-
BW007	~34	13 (0.38)	8 (0.235)	-	~30	~18	-
BW011a at 28	~35	13 (0.46)	7 (0.25)	-	- 44	~18	-
BW050	42	20 (0.32)	9 (0.21)	-	27	20	-
ABR271	47	19	10	-	38	35	-
ABR281	37	13	14	-	36	29	-
ABR30	24	10	8	-	32	17.5	-

**Description:** Shell of medium to large size (20 to 190 mm diameter) with rounded-subrectangular, a relatively wide umbilicus, and flat or gently rounded flanks. All the specimens exhibit the ornamentation typical of the species: thin, flexuous, fasciculate ribs on the initial and intermediate stage, developed from peri-umbilical bullae. Basically, the ribs have are sinusoidal, inclined forward (proverse ribs), towards the aperture. They often bifurcate on the upper part of the flanks and form a sinus on the ventral part. On the adult stage they broaden out and become strong and radial.

**Discussion:** It is not always easy to identify *Paradeshayesites oglanlensis* with certainty. Most *Deshayesitidae* of the *tuarkyricus* Zone, with the exception, perhaps, of *D. sp. aff. consobrinus*, are very densely ribbed, particularly on the phragmocone, and each rib is a sigmoidal curve of varying flexuosity. However, our specimens are similar in form and in sculpture to those illustrated by BOGDANOVA (1979, Pl. 2, figs. 5a-b; 1983, Pl. 1, figs. 1-9.).

**Occurrence:** Beds 62, 63, 78, 103, 105, La Bédoule (Les Caniers, Les Camerlots, Le Brigadan, Highway A52 sections), *P. oglanlensis* Zone.

**Distribution:** *P. tuarkyricus* Zone of Turkmenistan and Mangyshlak; *P. oglanlensis* Zone of SE France, Iran (Kopet-Dag).

### *Paradeshayesites sp. aff. planicostatus* (BOGDANOVA, 1991) (Pl. 1, figs. 7-8 & 10)

- aff. 1991 *Deshayesites planicostatus* BOGDANOVA, p. 80, Pl. 2, figs. 1-3; text-fig. 2.
- aff. 1999 *Deshayesites planicostatus* BOGDANOVA; AVRAM p. 447, fig. 6A (only).
- aff. 1999 *Deshayesites cf. planicostatus* BOGDANOVA; CECCA *et alii*, p. 279, Pl. 7, fig. 3.
- aff. 2004 *Paradeshayesites planicostatus* BOGDANOVA; BOGDANOVA & MIKHAILOVA, p. 214, Pl. 7, figs. 5-6; text-fig. 24.

**Material:** 4 complete specimens: ABR301, ABR33, ABR282, BW05, and several fragments of whorl.

#### Measurements:

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR301	58	26	15	-	30	-	-
ABR33	42	19 (d=40)	12.5 (d=40)	4	30	-	0.210
ABR282	39.5	16.8	12.5	-	30	-	-
BW05	38	16 (d=0.42)	11 (d=0.29)	-	30	-	-

**Description:** Small, moderately evolute ammonite, with flat or subparallel sides. The ribs are flexuous, simple or biplicate, branching between the middle and the upper third of the flank. These ribs start from bullae located on the periumbilical edge. Primaries and secondaries are slightly thickened and very strongly flattened on the upper part of the side. All are sigmoidal and describe a convexity towards the aperture across the venter.

**Discussion:** Our material shows most of the characters of the species, such as an angular umbilical margin, flat and curved ribs, umbilical bullae, but in ABR33 the umbilical width is less and the base of the sculpture is erased in several places on the sides. On ABR301, ribs are radial on the body chamber, not sinusoidal as in the type.

**Occurrence:** Beds 63, 67, 82, 86, La Bédoule (Les Caniers, Les Camerlots, and les Fourniers sections), *P. oglanlensis* Zone, Lower Aptian.

**Distribution:** *P. tuarkyricus* and *P. weissii* zones of Turkmenistan; Lower Aptian of Romania and *P. oglanlensis* Zone of SE France.

### *Paradeshayesites weissii* (NEUMAYR et UHLIG, 1881) (Pl. 4, fig. 4; Pl. 6, figs. 5 & 8; Pl. 7, fig. 2)

- 1881 *Hoplites weissii* nov. sp. NEUMAYR et UHLIG, p. 179, Pl. XLVI, figs. 1 & 1a; Pl. 47, fig. 1.
- 1902 *Hoplites weissii* NEUMAYR et UHLIG; KOENEN, p. 207, Pl. XLV, fig. 1.

- 1907 *Hoplites* cf. *weissi* NEUMAYR et UHLIG; KARAKASCH, p. 92, Pl. XI, fig. 2.
- non 1915 *Parahoplites weissi* (NEUMAYR et UHLIG), KILIAN & REBOUL, Pl. III, fig. 3; Pl. IV, fig. 4; Pl. VI, fig. 2
- 1964 *Deshayesites weissi* (NEUMAYR et UHLIG); CASEY, text-figs. 108 & 109a.
- non 1967 *Deshayesites weissi* (NEUMAYR et UHLIG); DIMITROVA, p. 183, Pl. 88, fig. 7.
- 1977 *Deshayesites weissi* (NEUMAYR et UHLIG); BOGDANOVA, p. 47, Pl. I, fig. 4; Pl. IV, fig. 6; text-fig. 2.
- 1977 *Deshayesites planus* CASEY; BOGDANOVA; Pl. III, figs. 4 a-b (only).
- 1995 ? *Deshayesites* aff. *callidiscus* CASEY; DELANOY, Pl. 1, fig. 1.
- 1999 *Deshayesites weissi* (NEUMAYR et UHLIG); AVRAM, p. 442, figs. 2 A-C.
- 1999 *Deshayesites weissi* (NEUMAYR et UHLIG); BOGDANOVA & PROZOROVSKY, p. 73, Pl. 4, figs. b-c.
- 2004 *Deshayesites weissi* (NEUMAYR et UHLIG); RAISSOSADAT, p. 127, fig. 4L.

**Material:** 6 complete specimens: RG1575, ABR29, ABR289, ABR187, ABR320, ABR016, one incomplete specimen: ABR50, and numerous fragments of whorls.

#### Measurements:

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
RG1575	85.5	37	32	19	40	-	0.542
ABR29	67	31	17	16	32	-	0.516
ABR289	42	15	13.5	-	29	-	-
ABR187	40.5	18.5	12	-	32	-	-
ABR320	~31	15	~10.5	-	~30	-	-
ABR016	27	13	8.5	3.5	~30	-	0.269

**Description:** Medium to small moderately involute shells, with a very steep umbilical wall, rounded venter and an umbilicus measuring between one third and one quarter of the total diameter, flanks sub-parallel. Sculpture consists of dense and thin sigmoidal ribs starting from the umbilical wall. They bifurcate at one third to half way up the sides. Some intermediate ribs can be intercalated between two main ribs at various heights on the flanks.

**Discussion:** We relate our specimens to the NEUMAYR & UHLIG's species because in many respects they resemble the ammonite illustrated by BOGDANOVA & PROZOROVSKY (1999, Pl. 4, figs. b-c). As reported by RAISSOSADAT (2004), in small specimens the ribbing is denser than in the larger ones.

**Occurrence:** Beds 110, 113, 115, 118, 120, Les Fourniers section, *Paradeshayesites weissi* Zone.

**Distribution:** *P. weissi* Zone of SE France, NW Germany, Turkmenistan; *P. weissi/albrechti-austriacae* Zone of the Northern Caucasus; Lower Aptian of the Ulyanovsk region (Russia) and Lower Aptian of Bulgaria.

### *Paradeshayesites weissiformis* (BOGDANOVA, 1983) (Pl. 1, figs. 5-6; Pl. 2, fig. 3)

- 1983 *Deshayesites weissiformis* BOGDANOVA, p. 134, Pl. 2, figs. 1-3; Pl. 3, fig. 7; text-figs. 3-4.
- 1995 *Deshayesites weissiformis* BOGDANOVA; DELANOY, p. 74, Pl. 5, fig. 2.
- 1999 *Deshayesites weissiformis* BOGDANOVA; ROPOLLO *et alii*, p. 179, Pl. 18, fig. 3.
- 1999 *Deshayesites weissiformis* BOGDANOVA; CECCA *et alii*, p. 278, Pl. 6, figs. 2-3.
- 1999 *Deshayesites weissiformis* BOGDANOVA; AVRAM, p. 440, figs. 3A & E.
- 2004 *Deshayesites* cf. *weissiformis* BOGDANOVA; RAISSOSADAT, p. 124, fig. 4J.
- 2004 *Paradeshayesites weissiformis* BOGDANOVA; BOGDANOVA & MIKHAILOVA, p. 212, Pl. 7, fig. 3; text-fig. 21.

**Material:** 8 specimens: BW003, BW022, ABR272, ABR278, ABR37, ABR38, ABR40, ABR143 (ROPOLLO Collection) and numerous fragments of whorl.

#### Measurements:

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
BW003	32.5	~13 (0.40)	8 (0.25)	-	34	-	-
BW022	39	20 (d=0.51)	5	-	39	-	-
ABR272	41.5	18	10	-	38	25	-
ABR278	~31	16	~10	-	-	-	-
ABR37	35.5	16	9	-	34	-	-
ABR38	28	12.6	8	-	34	-	-
ABR40	34	~16	8	-	36	-	-
ABR143	~31.5	~13 (d=22)	8.6 (d=22)	-	40	-	-

**Description:** Involute, discoidal shells with subparallel sides and rounded venter. Very steep umbilical wall. The dense ornamentation is rather irregular and consists of sinuous biplicate ribs and intercalatories starting from the lower fourth of the flank. The umbilical margin bears tubercles from which originate the sinusoidal main ribs. The point of branching of the biplicate ribs lies slightly above the mid-flank.

**Discussion:** Some specimens are compressed and broken. Others are well preserved. Because of similarities in sculpture, a relatively narrow umbilicus and morphologic resemblance, we include these ammonites in the group of *Paradeshayesites weissiformis* BOGDANOVA. However, they differ from the holotype in having a stronger and more flexuous ribbing.

**Occurrence:** Beds 64, 79, 80, 82, 106, 109, La Bédoule (Le Brigadan, Les Caniers, Highway A52, Les Camerlotts sections), *Paradeshayesites oganlensis* Zone.

**Distribution:** *P. tuarkyricus* Zone of Turkmenistan; *P. oganlensis* Zone of SE France; Lower Aptian of Mangyshlak (Kazakhstan), Kopet-Dag (Iran).

### 3) Genus: *Dufrenoyia* KILIAN et REBOUL, 1915

We include in this genus 10 species of ammonites with calcareous test collected in the Comte Quarry section from bed 171 to bed 178:

- *Dufrenoyia furcata* (SOWERBY, 1836),
- *Dufrenoyia dufrenoyi* (d'ORBIGNY, 1841),
- *Dufrenoyia formosa* CASEY, 1964,
- *Dufrenoyia fursovae* BOGDANOVA, 1991,
- *Dufrenoyia mackesoni* CASEY, 1964,
- *Dufrenoyia notha* CASEY, 1964,
- *Dufrenoyia sinzovi* LUPPOV, 1949,
- *Dufrenoyia* sp. gr. *transitoria/discoidalis* CASEY, 1964,
- *Dufrenoyia truncata* SPATH, 1930,
- *Dufrenoyia* sp.

#### *Dufrenoyia furcata* (J. de C. SOWERBY, 1836)

(Pl. 12, fig. 3; Pl. 13, fig. 1)

- 1836 *Ammonites furcatus* J. de C. SOWERBY (in FITTON), p. 339, Pl. XIV, fig. 17.
- 1915 *Parahoplites (Dufrenoyia) furcatus* (SOW.); KILIAN & REBOUL, p. 34, text-fig. 4.
- 1925 *Dufrenoyia furcata* (SOWERBY); BURCKHARDT, p. 17, Pl. X, figs. 12-13.
- non 1960 *Dufrenoyia furcata* (SOWERBY); DRUSHCHITS, p. 312, Pl. I (Part. 2), figs. 7 a-b.
- 1964 *Dufrenoyia furcata* (SOWERBY); CASEY, p. 378, text-figs. 135-136; Pl. 62, figs. 2-3; Pl. 63, fig. 1; Pl. 64, figs. 1a-1b.
- 1999 *Dufrenoyia furcata* (SOWERBY); BOGDANOVA, p. 353, Pl. II, figs. 8a-b; Pl. III, figs. 1a-b.
- 1999 *Dufrenoyia furcata* (SOWERBY); BOGDANOVA & PROZOROVSKY, Pl. 8, figs. d?e.
- 2003 *Dufrenoyia furcata* (SOWERBY); ROPOLO & GONNET, p. 24, Pl. 1, figs. 1-9.
- 2004 *Dufrenoyia furcata* (SOWERBY); BOGDANOVA & MIKHAILOVA, p. 219, Pl. 12, figs. 1-3; text-fig. 28.

**Material:** 4 calcareous specimens: ABR1425; C1426, C1428, C1429.

#### Measurements:

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR1425	22.6	12	7	7	14	n	0.583
C1426	17.2	8	5.6	6	14	-	0.75
C1428	22.6	10	6.5	6.2	14	-	0.62
C1429	19.2	10	7.5	6.1	14	n	0.61

**Description:** Small to medium sized discoidal shells, involute, with coarse ribbing, flat and angular venter, and moderately wide umbilicus. Ribs first broaden and then become spatulate on the upper part of the flanks and are terminated by clavi at the ventro-lateral shoulders. Sculpture (12/13 ribs by half whorl) consists of robust and slightly flexuous primaries, their inflexion directed forward, sometimes more prominent at the base of the flanks; intercalatories originate at the first third of the side. Occasionally secondaries show

bifurcation with the primaries, thus forming a two branched fork.

**Discussion:** This species, which was often not recognized as discrete from *Dufrenoyia dufrenoyi* (d'ORBIGNY) by French authors like ROCH (1927, p. 19), THOMEL (1980, p. 135) and ATROPS & DUTOIR (2002, p. 23), differs from d'ORBIGNY's in that it has fewer ribs per half whorl (12/13, not 16 to 18) and consequently the ribs are coarser and farther apart. On the young whorls costulation is more radial and less flexuous. *D. furcata* is morphologically very close to *D. lurenensis* KILIAN, but the latter has a more inflated shell and a more robust ribbing.

It is clear from our investigations in SE France that the biochron of *D. furcata* corresponds to the lower part of the *Dufrenoyia* interval and differs from that of *Dufrenoyia dufrenoyi*, which first appears later than *D. furcata* and has a longer stratigraphic range (cf. also DUTOIR, in press). Despite early attempts at clarification (e.g. CASEY, 1964, p. 382), confusion over the identification of the two species and the existence of two stratigraphical concepts (the *D. furcata* Zone and the vertical range of the genus *Dufrenoyia*) gave rise to controversy about the precise location of the upper limit of the Lower Aptian in SE France.

**Occurrence:** Beds 171, 172, 173, 174, 176, Comte Quarry section, *D. furcata* Zone.

**Distribution:** *D. furcata* Zone of southeastern France; *T. bowerbanki* Zone of England; *D. furcata* Zone of Turkmenistan; *D. furcata*/*D. subfurcata* Zone of the Northern Caucasus (Russia); Lower Aptian of Mangyshlak (Kazakhstan).

#### *Dufrenoyia dufrenoyi* (d'ORBIGNY, 1840)

(Pl. 12, fig. 2; Pl. 13, fig. 2)

- 1840 *Ammonites dufrenoyi* d'ORBIGNY, p. 200, Pl. 33, figs. 3-5.
- 1841 *Ammonites dufrenoyi* d'ORBIGNY, p. 200, Pl. 33, figs. 4-6.
- 1849 *Ammonites dufrenoyi* d'ORBIGNY; QUENSTEDT, p. 158, Pl. 10, fig. 10.
- 1897 *Hoplites dufrenoyi* (d'ORBIGNY); SARASIN, p. 769, fig. 6.
- 1960 *Dufrenoyia furcata* (SOWERBY); DRUSHCHITS, Pl. XXII, figs. 7a-b.
- 1961 *Dufrenoyia dufrenoyi* (d'ORBIGNY); ERISTAVI, p. 52, Pl. II, fig. 2.
- 1964 *Dufrenoyia dufrenoyi* (d'ORBIGNY); CASEY, p. 375, text-figs. 134 a & c.
- 1980 *Dufrenoyia furcata* (SOWERBY); THOMEL, p. 135, fig. 268.
- 1999 *Dufrenoyia dufrenoyi* (d'ORBIGNY); BOGDANOVA p. 353, Pl. III, figs. 2a-b.
- 1999 *Dufrenoyia dufrenoyi* (d'ORBIGNY); BOGDANOVA & PROZOROVSKY, Pl. 8, figs. a-c.
- 2003 *Dufrenoyia dufrenoyi* (d'ORBIGNY); ROPOLO & GONNET, p. 26, Pl. 1, figs. 10-12;



Pl. 2, figs. 1-6.

- 2004 *Dufrenoyia dufrenoyi* (d'ORBIGNY); BOGDANOVA & MIKHAILOVA, p. 219, Pl. 12, figs. 7-9.

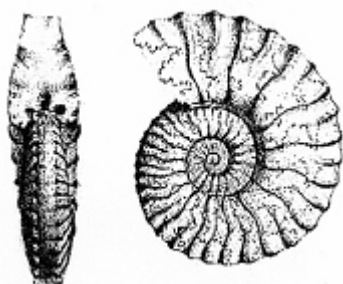
**Lectotype:** Designated by BOGDANOVA & MIKHAILOVA (2004) *ex* d'ORBIGNY (1841), "*Paléontologie française*", Pl. 33, figs. 4-5.

**Material:** 4 specimens: ABR332; C1456, C1458, C1459.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR332	52	24	14.2	14.8	18	n	0.62
C1456	50	21	17.6	12.2	18	-	0.58
C1458	42.6	17.8	13	10.5	18	-	0.59
C1459	33.2	15.2	10.1	8	18	n	0.53

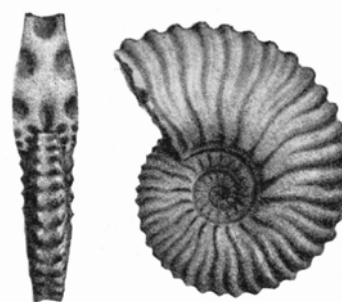
**Description:** Moderately evolute shell, trapezoidal in section, flat and angular venter with subangular margins, flat or gently convex sides. Ribs (16 per half whorl) radial, straight or slightly sinusoidal, ending on the venter in rounded clavi. Primaries and secondaries alternate regularly. Primaries start from the umbilical wall. Secondaries originate at the middle or at the first third of flank. All ribs tend to broaden and flatten as they approach the venter. As in *Dufrenoyia furcata*, the ribs seem sometimes to bifurcate at different height on the young whorls.



**Figure 5:** *Dufrenoyia dufrenoyi* (d'ORBIGNY, 1840); type of the "*Paléontologie française*" 1st edition (16 ribs per half whorl).

**Discussion:** Two illustrations of this species were published by d'ORBIGNY, as mentioned by BOGDANOVA & MIKHAILOVA (2004). The first one, in the first issue of "*Paléontologie française*" (1840, Pl. 33, figs. 3-5) (cf. Fig. 5 of this paper), represents an ammonite with thick whorls and relatively widely spaced ribs (16 by half whorl). The second is the figure included in the definitive edition (1841, Pl. 33, figs. 4-6); better known, this figure differs notably from the earlier illustration: narrower and higher whorls, more numerous and denser ribs (20 per half whorl). In his monograph on the Lower Greensand, CASEY (1964, p. 375, text-figs. 134 a-c) cited only the second figure and apparently considered it the sole valid one. We think that both morphotypes are conspecific and have found them in the same levels in SE France where specimens resembling the first figure are more common.

According to ATROPS & DUTOIR (2005) and DUTOIR (in press), in SE France this species appears after *Dufrenoyia furcata* and becomes extinct later. We agree with this later extinction of *D. dufrenoyi*, even though its range cannot be directly confirmed in the Cassis-La Bédoule area, where the Bedoulian-Gargasian transition is condensed and is now poorly exposed (MOULLADE *et alii*, 2005); but our investigations in the Aptian type-area of Gargas (near Apt, SE France) (ROPOLO & MOULLADE, 2002) as well as in the Vocontian Basin, have determined that its paracme may coincide with the FAD of *Acanthoplites aschiltaensis*; indeed, in the Gargasian of Lioux and Carniol (respectively located 10 km NW and 20 km NE of Apt) we have collected several specimens of *A. aschiltaensis* occurring together with *D. dufrenoyi*.



**Figure 6:** *Dufrenoyia dufrenoyi* (d'ORBIGNY, 1841); 2nd representation of "*A. Dufrenoyi*" in the definitive edition of the "*Paléontologie française*" (20 ribs per half whorl).

**Occurrence:** Beds 173, 175, 176, Comte Quarry section, *D. furcata* Zone.

**Distribution:** *D. furcata* Zone (and basal Gargasian) of southeastern France; *D. furcata* Zone, Turkmenistan; Lower Aptian ("*plita*") of Mangyschlak (Kazakhstan); Lower Aptian of Mexico.

### *Dufrenoyia formosa* CASEY, 1964

- 1964 *Dufrenoyia formosa* nov. sp. CASEY, pp. 395, Pl. LXIII, fig. 3; Pl. LXV, fig. 3; Pl. LXVI, figs. 4-5.
- 1976 *Dufrenoyia formosa* CASEY; PEYBERNÈS, p. 280, Pl. XXV, figs. 3-4.
- 2003 *Dufrenoyia formosa* CASEY; ROPOLO & GONNET, p. 34; Pl. 5, figs. 1-4.

**Material:** Two calcareous specimens: C1432, C1501.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
C1432	16.2	8	6	5	18	-	0.625
C1501	16	7.9	5.8	5	18	-	0.632

**Description:** Discoidal and moderately evolute shell with a subelliptical whorl section, wider at the first third of flanks. Ribbing (18 ribs by half whorl) consists of radial or feebly sinusoidal primaries, and shorter secondaries

originating from the first third of the flank. The ventral area is flat and smooth, edged by marginal clavi which terminate each rib. On juvenile whorls it is sometimes possible to distinguish bundles of two, three or four flexuous ribs or a succession of bifurcated ribs fusing at mid flank.

**Discussion:** The nuclei of *Dufrenoyia formosa* can show a succession of bifurcated ribs as in one (Pl. LXV, fig. 3) of the specimens illustrated by CASEY, 1964. Generally, primaries and secondaries are not in contact.

**Occurrence:** Bed 175, Comte Quarry section, *D. furcata* Zone.

**Distribution:** *T. bowerbanki* Zone of England, Lower Aptian of Ramade (Western Pyrénées, SW France), *D. furcata* Zone of Cassis La Bédoule, Aptian marls of the Vocontian Basin and of the type-region of Gargas (SE France).

### ***Dufrenoyia fursovae* BOGDANOVA, 1991 (Pl. 10, fig. 8; Pl. 13, fig. 3)**

- 1991 *Dufrenoyia fursovae* BOGDANOVA, p. 88, Pl. 2, figs. 9-11; text-fig. 6.
- 1999 *Dufrenoyia fursovae* BOGDANOVA; BOGDANOVA, p. 352, Pl. II, figs. 10a-b.
- 1999 *Dufrenoyia fursovae* BOGDANOVA; BOGDANOVA & PROZOROVSKY, p. 80, Pl. 8, fig. g
- 2003 *Dufrenoyia fursovae* BOGDANOVA; ROPOLO & GONNET; p. 31, Pl. 5, figs. 9-11.
- 2004 *Dufrenoyia fursovae* BOGDANOVA; BOGDANOVA & MIKHAILOVA, p. 220, Pl. 12, fig. 10; text-fig. 29.

**Material:** 3 complete calcareous specimens on gangue: ABR602 a & b, C1503; one incomplete spire: C604; plus 3 fragments (CONTE collection).

#### **Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR602a	32.5	15	10.2	-	28	-	-
ABR602b	33.5	15.5	10.5	-	28	-	-
ABR602b	45.2	21	12	-	28	-	-
ABR602b	27.5	12.5	9	-	28	-	-

**Description:** Small, moderately involute ammonite, with a subelliptical whorl section and slightly convex flanks. Ribbing very dense, with 28 ribs by half whorl. The sculpture consists of long sinusoidal primaries starting from the umbilical wall and shorter secondaries appearing sometimes at the first third of the flank, and even sometimes at mid flank. Venter flat and smooth, with thin marginal tubercles lengthening each rib. This species has usually two secondaries between neighbouring main ribs.

**Discussion:** *Dufrenoyia fursovae* BOGDANOVA resembles *D. sinzovi* LUPPOV but its ribbing is denser and more flexuous. Intermediaries are

often single or in pairs and never join the primary ribs.

**Occurrence:** Bed 171, Comte Quarry section, *D. furcata* Zone.

**Distribution:** *D. furcata* Zone of Turkmenistan, Lower Aptian of Mangyshlak, *D. furcata* Zone of Cassis-La Bédoule (SE France).

### ***Dufrenoyia mackesoni* CASEY, 1964 (Pl. 13, figs. 7-8)**

- 1964 *Dufrenoyia mackesoni* CASEY, p. 397, Pl. LXIII, figs 5a-b; Pl. LXV, figs. 4a-b; text-figs. 140d-144.
- 2003 *Dufrenoyia mackesoni* CASEY; ROPOLO & GONNET, p. 36, Pl. 4, figs. 7-11.

**Material:** Two calcareous specimens: C611, C612.

#### **Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
C611	48	22	19	-	18	-	-
C612	62	24.8	20.7	-	18	-	-

**Description:** Small to medium-sized moderately evolute shell, with slightly convex flanks and a subrectangular whorl section. Angular to subangular venter bordered by weak marginal clavi. The costation of moderate relief consists of a regular alternation of primaries starting from the umbilical wall and secondaries originating at mid flank. Primaries tend to flatten on the upper third of the flank. All ribs are falciform. According to CASEY (1964), the interspaces are a little wider than the ribs.

**Discussion:** Our specimens are very similar to the holotype, Pl. LXV, figs. 4a-b, in CASEY, 1964. Under the designation "*Dufrenoyia cf. mackesoni*" this author describes and illustrates (p. 398, text-fig. 144) a calcareous adult specimen from La Bédoule (La Sorbonne collections). This very evolute ammonite has a diameter of 115 mm, a wider umbilicus (= half total diameter instead of one third) and more numerous (20/21 instead of 18) ribs per half whorl than our specimens.

**Occurrence:** Beds 171, 173, 176, Comte Quarry section, *D. furcata* Zone.

**Distribution:** *T. bowerbanki* Zone of England, *D. furcata* Zone of Cassis-La Bédoule, Aptian marls of the Vocontian Basin and of the type-region of Gargas, Lioux, La Tuilière (SE France).

### ***Dufrenoyia notha* CASEY, 1964 (Pl. 12, fig. 4; Pl. 14, fig. 7)**

- 1930 *Dufrenoyia furcata* (J. de C. SOWERBY); SPATH, p. 435-436 (pars).
- 1964 *Dufrenoyia notha* CASEY; p. 386, Pl. LXIII, figs. 8a-b; Pl. LXIV, figs. 5a-b; text-fig. 140 j.

- 2003 *Dufrenoyia notha* CASEY; ROPOLO & GONNET, p. 30, Pl. 3, figs. 6-11.

**Material:** 5 specimens: ABR333, ABR1431, ABR1433, ABR1434, ABR1435.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
ABR333	42.8	18.2	12.6	~8.2	14	-	0.45
ABR1431	32.6	13.2	11.5	~8	14	-	0.61
ABR1433	26.8	12	9.8	7	14	-	0.58
ABR1434	21	8	8	~5	14	-	0.63
ABR1435	20	7.2	8	~5	14	-	0.69

**Description:** Small to medium-sized discoidal and evolute shell. In the juvenile stage the whorl section is subtrapezoidal with slightly rounded flanks. In the adult stage the whorl section becomes progressively subrectangular. The ornamentation (14 ribs by half whorl) shows in alternation long radial primaries starting from the periumbilical wall, and shorter intermediate ribs originating from the first third of the flank. On the juvenile whorls ribs occasionally have an incipient bifurcation and become gently sinuous. All ribs run straight over the venter, forming parallel marginal clavi on both sides.

**Discussion:** *Dufrenoyia notha* CASEY shows some similarities with *D. furcata* (SOWERBY). However, the latter is more involute and has ribs more widely spaced and more forked, as well as more angular margins on the venter area.

**Occurrence:** Beds 172, 173, 174, 176, Comte Quarry section, *D. furcata* Zone.

**Distribution:** *T. bowerbanki* Zone of England, *D. furcata* Zone of southeastern France.

***Dufrenoyia sinzovi* LUPPOV, 1949  
(Pl. 13, fig. 4)**

- 1949 *Dufrenoyia sinzovi* sp. LUPPOV, p. 228, Pl. 66, figs. 1a-b.
- 1999 *Dufrenoyia sinzovi*, LUPPOV; BOGDANOVA & PROZOROVSKY, p. 80, Pl. 8, figs. f & h-i.
- 2003 *Dufrenoyia sinzovi* LUPPOV; ROPOLO & GONNET, p. 32, Pl. 2, figs. 4-8.

**Material:** A fragment of whorl (C649)

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
C649	~41	20	~17	-	~22	-	-

**Description:** We have attributed to LUPPOV's species a fragmentary whorl with a costulation similar to that of the type. Dense sinusoidal ribbing, alternation of primaries starting from the umbilical area and intercalatories originating at the first third of the flank. Ventro-lateral clavi are indistinct.

**Discussion:** This taxon is a typical

Mediterranean ammonite, never found in the Boreal Realm.

**Occurrence:** Bed 174, Comte Quarry section, *D. furcata* Zone.

**Distribution:** *D. furcata* Zone of Turkmenistan, Lower Aptian of the Volga region (Russia), *D. furcata* Zone of southeastern France.

***Dufrenoyia* sp. gr. *transitoria* CASEY,  
1961/*discoidalis* CASEY, 1964  
(Pl. 13, figs. 5-6)**

- 1961 *Dufrenoyia transitoria* sp. nov., CASEY, p. 594, Pl. 83, figs. 3a-b.
- 1964 *Dufrenoyia discoidalis* sp. nov., CASEY, p. 393, Pl. LXVI, figs. 7-8; text-fig. 140g.

**Material:** One complete specimen C658, one fragment of whorl C662

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
C658	66	27.8	22.5	18	30	-	0.647
C662	78	36	?	-	-	-	-

**Measurements:**

**Description:** Small to medium-sized discoidal and evolute ammonite with a subrectangular whorl section. Sides gently convex. Sculpture consisting of sigmoidal primary ribs starting from a vertical umbilical wall and tending to flatten on the uppermost part of the flanks, and flexuous secondaries originating more or less at the mid flank or in the first third of the flank. Some of these secondaries are unite with the primaries. All ribs are separated by narrow interspaces. They terminate in pronounced ventral clavi joined by bar-like swellings on the flat venter. The umbilicus size is one third of the total diameter.

**Discussion:** In England and in SE France this group seems to characterize the basal part of the respective zones (*T. bowerbanki* and *D. furcata*).

**Occurrence:** Beds 171, 173, Comte Quarry section, *D. furcata* Zone.

**Distribution:** *T. bowerbanki* Zone (*D. transitoria* Subzone) of England, *D. furcata* Zone (lower part) of Cassis-La Bédoule and of southeastern France.

***Dufrenoyia truncata* SPATH, 1930  
(Pl. 14, figs. 1-3)**

- 1930 *Dufrenoyia truncata* SPATH, pp. 436, Pl. XVI, figs. 4b-c.
- 1964 *Dufrenoyia truncata* SPATH, CASEY, p. 392, Pl. LXII, figs. 1a-b; Pl. LXIII, figs. 4 & 7a-b; text fig. 140f.

**Material:** 3 calcareous specimens: C660, C668, C669.

**Measurements:**

specimens	D	Wh	Uw	Wb	K	Ph	Wb/Wh
C660	61	30.2	22	-	20	-	-
C668	82.5	37	24	-	20	-	-
C669	63	22	20	-	20	-	-

**Description:** Small to medium-sized discoidal and evolute ammonite, similar to *Dufrenoyia transitoria* in ribbing pattern, with sinusoidal primaries starting from the umbilical wall and secondaries originating from mid flank. However, in *D. truncata* the interspaces are wider, the ribs are less numerous (20 per half whorl), the periumbilical area is less angular and flanks are gently convex.

**Discussion:** *Dufrenoyia truncata* is often difficult to differentiate from *D. transitoria* from which, according to CASEY (1964, p. 392), it differs only "in its slightly coarser ribbing".

**Occurrence:** Beds 174, 176, Comte Quarry section, *D. furcata* Zone.

**Distribution:** *T. bowerbanki* Zone (*D. transitoria* Subzone) of England, *D. furcata* Zone of Cassis-La Bédoule.

***Dufrenoyia* sp.  
(Pl. 14, fig. 5)**

**Material:** One complete specimen (C1590) and several fragments.

**Measurements:**

specimen	D	Wh	Uw	Wb	K	Ph	Wb/Wh
C1590	41	22	10	8	18	-	-

**Description:** Small involute ammonite with radial ribs and rounded venter on the body chamber, dense sigmoidal ribs and flat venter on juvenile whorl. Primaries start from a vertical umbilical wall. Intercalatories, often single, take originate either from mid flank or from the first third of the flank.

**Discussion:** This ammonite is probably a crushed juvenile specimen and has a close resemblance to *Deshayesites*. But taking into account its flat venter, even though partly visible, and the level where it was collected, we refer it to the genus *Dufrenoyia*.

**Occurrence:** Beds 174-176, Comte Quarry section, *D. furcata* Zone.

**Distribution:** *D. furcata* Zone of Cassis-La Bédoule.

**Summary and discussion of the main  
biostratigraphic results**

Updating the paleontological study of the Cassis-La Bédoule area allowed us to determine more precisely the stratigraphic distribution of Uppermost Barremian/Lower Aptian ammonite assemblages in the historical stratotype. In every section examined we recorded bed by bed

the succession of populations and therefore were able to record faunal changes step by step. In particular we collected in place and thus re-located the standard stratigraphic markers commonly accepted for use in the Tethyan Realm. These additional data are of major importance for the definition of biostratons and confirm our previously proposed stratigraphic scheme (ROPOLO *et alii*, 2000b).

In the uppermost part (beds 45 – 60) of the Barremian stage, the abundance of heteromorphic ammonites of the genus *Pseudocrioceras* characterizes the *P. waagenoides* Zone (or Subzone). Never in these beds nor in overlying and underlying strata did we find specimens of *Turkmeniceras sensu stricto*. Conversely, as yet no specimens of *Pseudocrioceras* have been reported in the *Turkmeniceras* levels of Turkmenistan. However, according to DELANOY (oral communication, 2005) *Turkmeniceras* occur at Angles, Barrême, and Vergons (Vocontian basin, SE France) in layers overlying the first occurrence of the genus *Deshayesites* (about 3-4 meters above the "faisceau épais"). DELANOY also found a unique specimen of *Turkmeniceras* in a condensed level in the Nice area. Nevertheless, as the exact stratigraphic position of this genus remains uncertain in SE France, it is not possible at this time to recognize a *Turkmeniceras turkmenicum* Zone in this region. In any event, we consider *Pseudocrioceras waagenoides* a more appropriate index for defining the terminal Barremian Zone (or Subzone) and consequently the Barremian/Aptian boundary.

From bed 61 to bed 178, the *Deshayesitidae* represent the dominant family among the ammonite groups that characterize the Lower Aptian deposits of Cassis-La Bédoule. Four biozones are defined by the successive first appearances of the following index species: *Paradeshayesites oglanlensis*, *Paradeshayesites weissii*, *Deshayesites deshayesi*, and *Dufrenoyia furcata*. These biozones take into account the evolution of the genera *Paradeshayesites*, *Deshayesites* and *Dufrenoyia* and their relationships with the other ammonite assemblages. In the historical stratotype they allow the recognition of chronostratigraphic subdivisions which now conform more exactly with the current Mediterranean standard scheme and so make correlations with other regions of the world easier.

**Beds 61-109: *Paradeshayesites oglanlensis* Zone:** The assemblage from this zone is represented successively by: *Deshayesites bedouliensis* CECCA, ROPOLO et GONNET, 1999, *Paradeshayesites oglanlensis* (BOGDANOVA, 1983), *Paradeshayesites planicostatus* (BOGDANOVA, 1991), *Paradeshayesites weissiformis* (BOGDANOVA, 1983), *D. luppovi* BOGDANOVA 1983, *D. aff.*

*consobrinus* (d'ORBIGNY, 1841), *D. cf. luppovi*  
 BOGDANOVA 1983, *Paradeshayesites* cf.  
*weissiformis* (BOGDANOVA, 1983),

*Paradeshayesites* aff. *weissiformis* (BOGDANOVA, 1983), *Paradeshayesites* aff. *planicostatus* (BOGDANOVA, 1991).

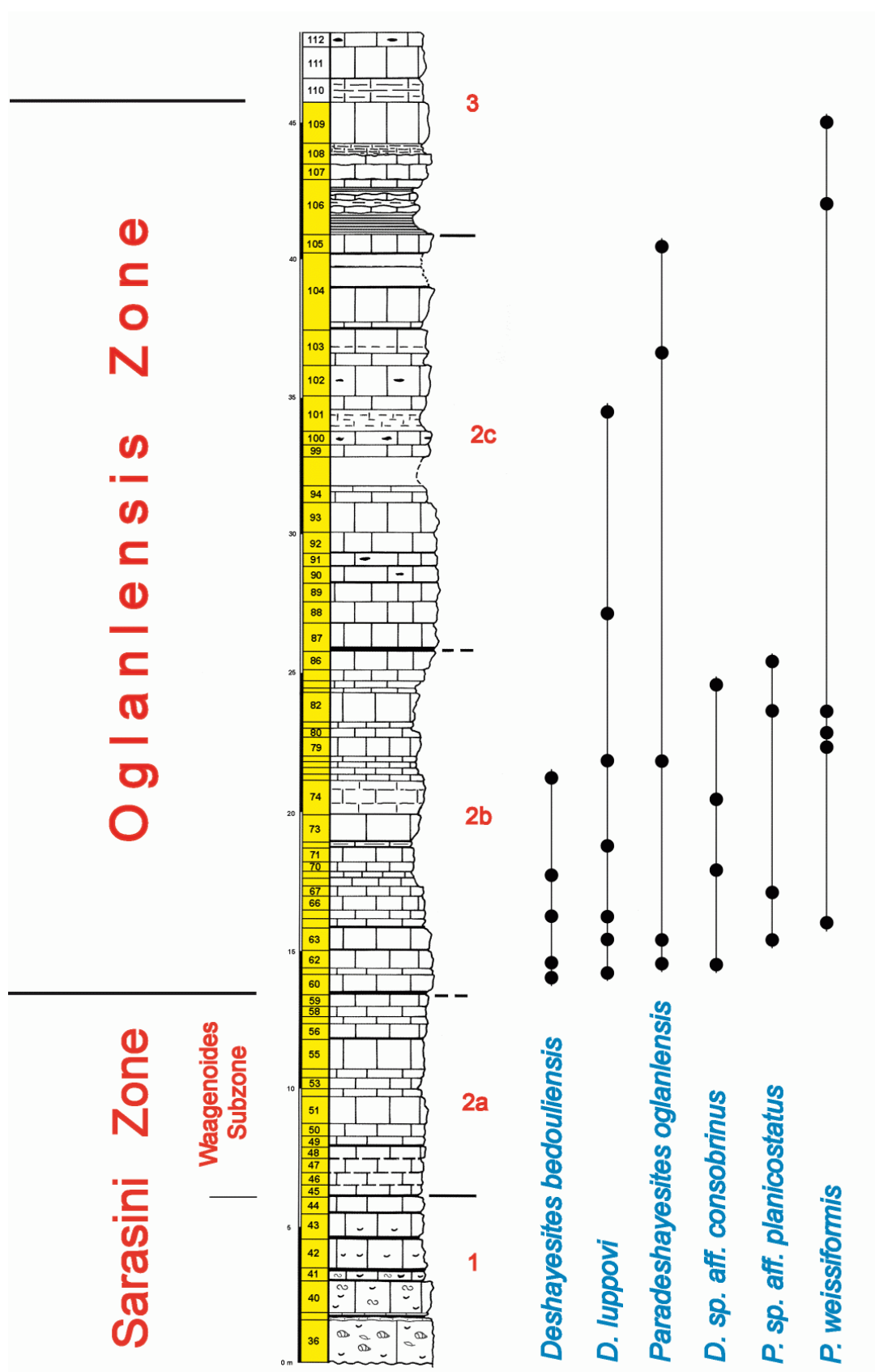


Figure 7.

Figures 7-9: Lower Aptian composite section of the Cassis-La Bédoule area, with the position of the collected species (Deshayesitidae *p.p.* max.). Lithologic unit and bed numbering is that used in MOULLADE *et alii* (2000b).



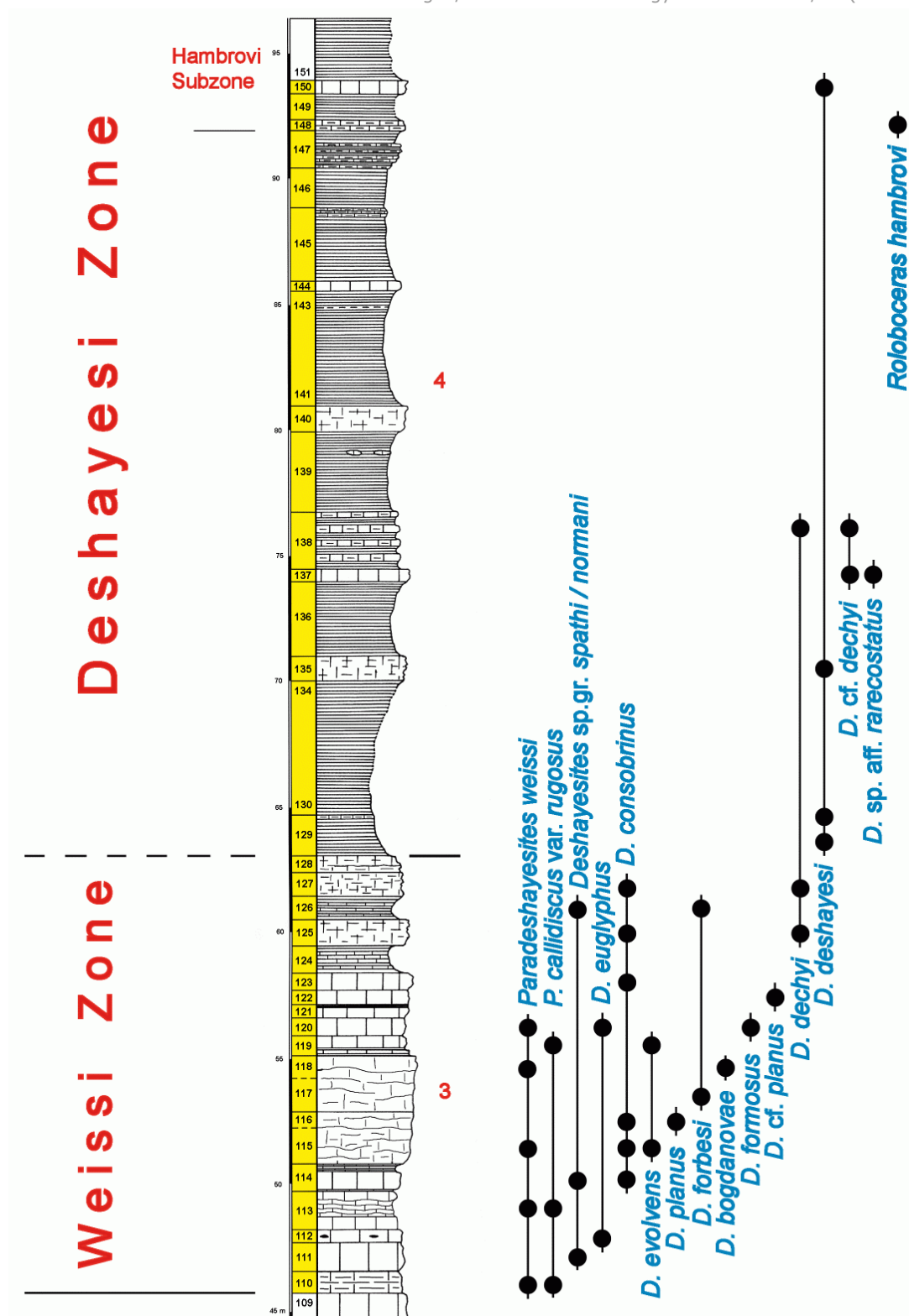


Figure 8.

**Beds 110-128: *Paradeshayesites weissi* Zone:** In this interval we collected: *Paradeshayesites weissi* (NEUMAYR et UHLIG, 1881), *Paradeshayesites callidiscus* var. *rugosus* (CASEY, 1961), *Deshayesites* gr. *spathi/normani* CASEY, 1964, *D. consobrinus* (d'ORBIGNY, 1841), *D. gr. spathi/normani*, *D. forbesi* CASEY, 1961, *D. bogdanovae* AVRAM, 1999, *D. evolvens* LUPPOV, 1952, *D. formosus*

CASEY, 1964, *D. euglyphus* CASEY, 1964, *D. cf. planus*, CASEY, 1964, *D. dechyi* PAPP, 1907, *D. cf. dechyi* PAPP, 1907.

**Beds 129-148: *Deshayesites deshayesi* Zone (lower part):** *Deshayesites deshayesi* (LEYMERIE, 1841), *D. cf. dechyi* PAPP, 1907, *D. rarecostatus* BOGDANOVA, KVANTALIANI et SHARIKADZE, 1979.

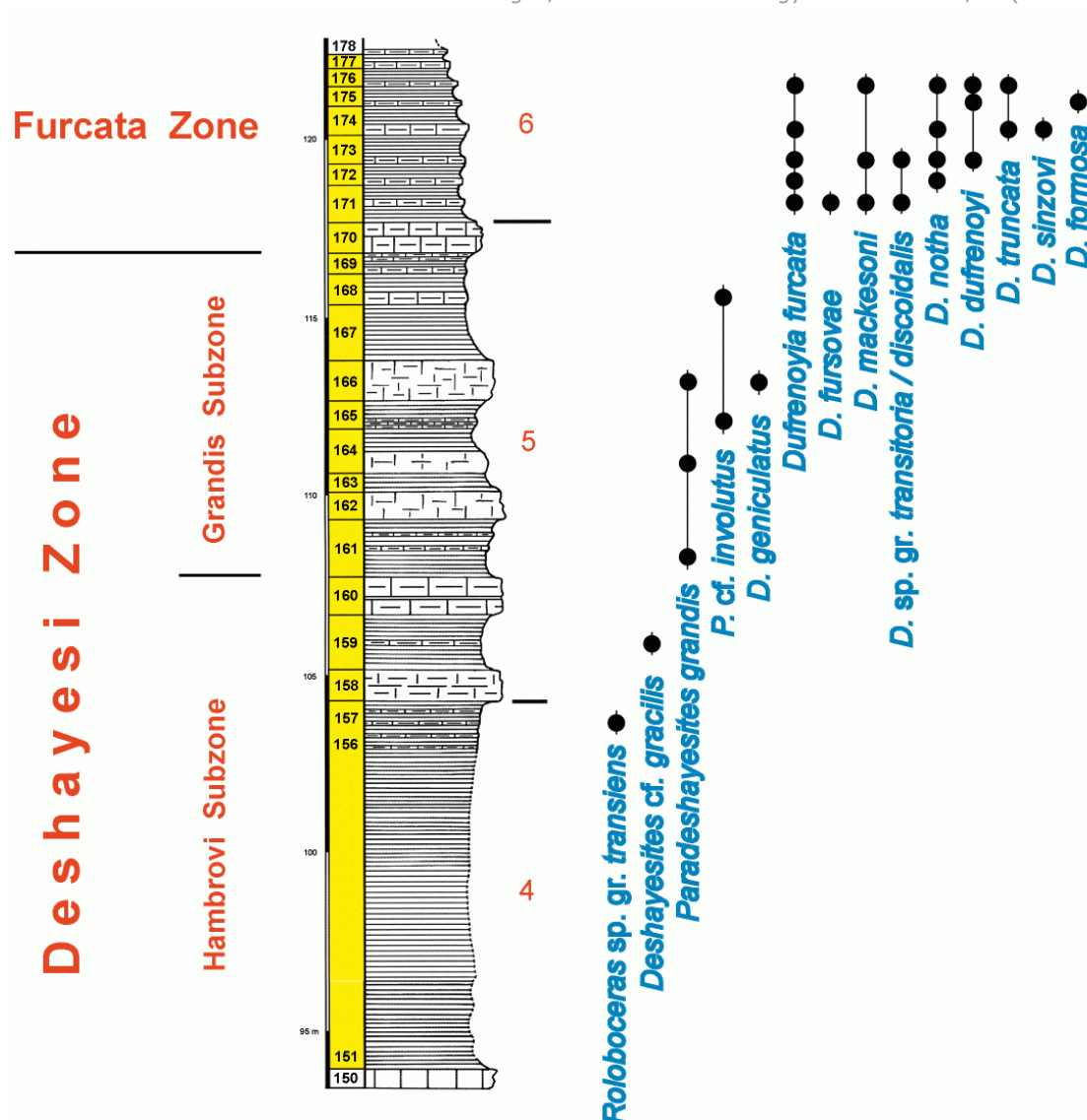


Figure 9.

**Beds 149–160: *Deshayesites deshayesi* Zone, *R. hambrovi* Subzone:** *D. cf. gracilis* CASEY, 1964 (and numerous *Roloboceras* gr. *hambrovi/transiens*, *Megatyloceras* gr. *coronatum/ricordeanum*).

**Beds 161–170 *Deshayesites deshayesi* Zone, *Paradeshayesites grandis* Subzone:** *Paradeshayesites grandis* (SPATH, 1930), *P. cf. involutus* (SPATH, 1930), *P. geniculatus* CASEY, 1964.

**Beds 171–178 *Dufrenoyia furcata* Zone:** *Dufrenoyia furcata* (SOWERBY, 1836) *D. fursovae* BOGDANOVA, 1991, *D. dufrenoyi* (d'ORBIGNY, 1840), *D. notha* CASEY, 1964, *D. sinzovi* LUPPOV, 1949, *D. truncata* CASEY, *D. formosa* CASEY, 1964, *D. mackesoni* CASEY, 1964.

The boundaries of the *D. furcata* zone at Cassis-La Bédoule were defined on:

- the first occurrence of *Dufrenoyia furcata sensu stricto* for the lower boundary,
- the first occurrence of the pyritized *Aconeceras nissus* / *Epicheloniceras martini* assemblage for the upper boundary, which

coincides with the lower limit of the Middle Aptian (Gargasian).

The micropaleontological revision of MOULLADE *et alii* (2005) of the Gargasian series in the Cassis area showed that several benthic foraminiferal species (*Praedorothia praeoxycona*, *Lenticulina cf. nodosa*, *Astacolus crepidularis*, *Globorotalites bartensteini*) as well as an ostracode (*Protocythere bedoulensis*) become extinct at or very near the top of the Bedoulian, while two planktonic species (*Praehedbergella luterbacheri*, and *Globigerinelloides ferreolensis*) first appear respectively near and slightly above the Bedoulian/Gargasian boundary. These data, which will be confirmed at La Tuilière in the Aptian historical stratotypic area (MOULLADE *et alii*, *in prep.*), do not contradict, but even strengthen the choice of placing the Bedoulian-Gargasian boundary at the top of the *D. furcata* Zone (bed 178 in the Bedoulian stratotype) as initially proposed by CONTE (1994) and reaffirmed in this paper.

Some authors (ATROPS & DUTOIR, 2002) are of the opinion that the ammonite fauna of the

*Dufrenoyia furcata* Zone has more affinities with that of the Middle Aptian *Subnodosocostatum* Zone than with the Bedoulian forms and suggest that the Bedoulian/Gargasian boundary be placed at the top of the *Deshayesites deshayesi* Zone, i.e. at the base of the *Dufrenoyia furcata* Zone ["À Gargas, et dans les localités voisines de Carniol, de Simiane et d'Oppedette, la très abondante faune d'ammonites provient de la base du Gargasien, selon son acception originelle (KILIAN, JACOB). Il s'agit du Gargasien inférieur (zone à *Aconeceras nissus* et *Dufrenoyia furcata* = *dufrenoyi*) (...)"

"(...) En outre, d'après nos récoltes, il apparaît clairement que le genre *Dufrenoyia* se poursuit jusque dans la Zone à *Subnodosocostatum* (...)"

" (...) Pour toutes ces raisons, nous pensons que la limite Bédoulien/Gargasien doit désormais être placée entre les zones à *Deshayesi* et à *Furcata*, cette dernière étant réintégrée à la base du Gargasien qui retrouve ainsi son acception première." (ATROPS & DUTOIR, 2002, p. 23)].

We believe that this proposal is based on the misidentification of two discrete species, *Dufrenoyia furcata* (SOWERBY) and *D. dufrenoyi* (d'ORBIGNY). We have shown above that: 1) these taxa are morphologically distinct and differ in their stratigraphic ranges 2) the duration of the *D. furcata* Zone and the stratigraphic range of the genus *Dufrenoyia* do not coincide, the latter being longer than the biochron of the index-species.

There are fundamental differences between the *D. furcata* Zone of Cassis-La Bédoule as defined and the marly levels containing specimens of *Dufrenoyia* in the type-locality of Gargas (near Apt, SE France) and nearby tracts (for example several outcrops at La Tuilière, near Saint-Saturnin-les-Apt), or in several sections of the Vocontian Basin. At Cassis-La Bédoule all the fossils from this zone are calcareous shells, collected painstakingly in well-defined alternating marly limestones and calcareous beds; all the *Dufrenoyia* found in the Apt-Gargas area and in the Vocontian Basin are pyritized ammonite nuclei, collected more or less haphazardly in a homogeneous marly sequence, in which a precise stratigraphic assignment is often difficult. Furthermore, at Cassis-La Bédoule the index-ammonite occurs in calcareous beds along with *Tropaeum bowerbanki*, a boreal form which characterizes the upper part of the Lower Aptian in Southern England. To our knowledge *Tropaeum* has not been found in the marls of the Apt area or in the Vocontian Basin. The *Dufrenoyia* associated with *Tropaeum bowerbanki* mentioned in literature are generally assigned a Lower Aptian age (CASEY, 1961, p. 496-497; 1980, p. 637; EGOIAN, 1969, p. 127; KEMPER, 1971, p. 364;

BOGDANOVA, 1978, p. 78; KAKABADZE *et alii*, 1978, p. 81; KAKABADZE, 1981, p. 154; KEMPER, 1982, p. 24; MIKHAILOVA, 1983, p. 321; BOGDANOVA & TOVBINA, 1994, p. 55; BARABOSHKIN & MIKHAILOVA, 2002, Pl. 3, fig. 4; BOGDANOVA & MIKHAILOVA, 2004, p. 195). Moreover, in the succession from bed 171 to bed 178 in Cassis-La Bédoule, we found no *Aconeceras nissus*, which first appears only above bed 178. In the Apt-Gargas area, this species co-occurs with *Dufrenoyia*. Thorough investigations in both sectors show that the vertical range of *Dufrenoyia furcata* is restricted to the basal part of the range of the genus *Dufrenoyia*. Other species of this genus, such as *D. dufrenoyi* (d'ORBIGNY, 1840), *D. notha* CASEY, 1964, *D. truncata* CASEY, 1964, *etc.* lived longer.

According to the rules of the International Stratigraphic Commission, it is not necessary that the biochron of an ammonite-index coincides precisely with the duration of the eponymous Zone. The Lower/Middle Aptian boundary was commonly placed at the first occurrence of *Epicheloniceras subnodosocostatum* (CONTE, 1985; KOTETISHVILI, 1986; HOEDEMAEKER & BULOT, 1990; BOGDANOVA & TOVBINA, 1994; BOGDANOVA & PROZOROVSKY, 1999; HOEDEMAEKER & RAWSON, 2000). It appears that this taxon and/or other species of this genus may briefly co-occur with *Dufrenoyia* (DUTOIR, in press).

The *D. furcata* Zone of Cassis-La Bédoule and in general of SE France is correlated with the *Furcata* Zone of the Trans-Caspian regions (Resolution of Samarkand, 1977), the *Furcata* Zone of Turkmenia (BOGDANOVA 1978), the *Furcata/Subfurcata* Zone of Northern Caucasus (DRUSHCHITS *et alii*, 1986; KOTETISHVILI, 1986), the *Bowerbanki* Zone of England (CASEY, 1961, 1998), the *Dufrenoyia justinae* Zone of Northeast Mexico (BARRAGÁN-MANZO & MENDES-FRANCO, 2005), and the Lower Aptian of Mangyshlak (BOGDANOVA, 1999). All these zones are assigned a Lower Aptian age. That this biostratigraphic entity be considered Middle-Aptian, as suggested by ATROPS & DUTOIR (2002) and DUTOIR (in press), would introduce inconsistencies among these well-established correlations.

However, given the present state of our knowledge a problem seems to exist, because the genus *Dufrenoyia* appear to have a longer vertical range in SE France than in other Mediterranean areas. This anomaly might be due mainly to the higher rate of sedimentation in the marly sequence that comprises the Bedoulian-Gargasian transition in the Aptian historical stratotypes; this increase in rate is documented by the distribution of microfossils (MOULLADE *et alii*, 2000c, 2005).

The definition of stratigraphic subdivisions such as stages is somewhat conventionalized, if not even artificial, and this is even more true of

substages. Historically, their limits have been based most often on faunal or facies changes believed to be well-marked. Zones and horizons are commonly delimited by the first occurrence of an index species or sometimes by the co-occurrence of an association of species. These subdivisions are accepted according to their ease of use and the possibilities they offer for correlation between discrete geographic areas. To avoid the incidence of too many misinterpretations and ambiguities, it is preferable to maintain a relative stability in stratigraphic nomenclature rather than to change the limits continually because of taxonomic changes and/or the discovery of new fossils. Historically, in the Lower Aptian stratotype the Bedoulian-Gargasian boundary has been founded on changes in facies and fauna believed to be sharply demarcated and simultaneous (FABRE-TAXY *et alii*, 1965). Later studies of the faunal content have shown that the representatives of the genus *Dufrenoyia* can co-exist with ammonites of the Lower Aptian (CONTE, 1994). And more detailed research involving lithology, sedimentology and geochemistry has shown that the change of facies is more gradual (MOULLADE *et alii*, 2000b; MASSE, 2000; RENARD & de RAFÉLIS, 2000). Whatever the case may be, it seems more appropriate to define the Bedoulian on the basis of a monophyletic zonation, taking into consideration the successive steps in the evolution of the Deshayesitidae, to which the genus *Dufrenoyia* belongs.

Furthermore, throughout the continuum of faunal evolution the passage from one biozone to another is rarely delimited sharply. If ammonite assemblages evolve in marked fashion at the beginning of the *D. furcata* Zone, their evolution is even more important in the basal Gargasian where the ammonite fauna is even richer and more diverse: the extinction of *Dufrenoyia* is almost coincident with the appearance of numerous new species of *Epicheloniceras* [*E. martini* (d'ORBIGNY), *E. martini* var. *orientalis* (SAYN), *E. martini* var. *caucasica* (ANTHULA), *E. martinoides* CASEY, *E. tschernyschewi* (SINZOW), *E. subnodosocostatum* (SINZOW), [*E. buxtorfi* (JACOB)], *Parahoplites* [*P. melchioris* ANTHULA, *P. transitans* SINZOW, *P. maximus* SINZOW, *etc.*], *Acanthoplites* [*A. ashiltaensis* ANTHULA)], *Colombiceras* [*C. crassicoatum* (d'ORBIGNY), *C. caucasica* LUPPOV, *C. tobleri* (JACOB et TOBLER)] and many Phylloceratinae.

For all of these reasons we propose to maintain the existing statu quo, that is to define the limit between the Lower and Middle Aptian by the FAD of *E. subnodosocostatum*. This datum is approximately coincident with the disappearance of the genus *Dufrenoyia* and consequently our proposal leads us to restrict the whole range of the *D. furcata* Zone to the lower Aptian.

## Conclusion

In this paper we have attempted:

- 1) to give a detailed, bed-by-bed inventory of the faunal content of the zones of the Lower Aptian in the Cassis-La Bédoule area
- 2) to update to some extent the systematic descriptions of their respective faunas. The evolution of Lower Cretaceous ammonites in the stratigraphic succession as it can be traced at Cassis-La Bédoule is very instructive and may be used as a guide to improve the placement of isolated fossil finds in other regions, like southeastern France. Our results show clearly that the doubts expressed by several Russian authors (see above – the introductory portion of this paper) are not justified and that the historical stratotype may still constitute a type-locality usable for Lower Aptian biostratigraphy in the Mediterranean domain.

The principal stages of this evolution may be summarized as follows:

In the Tethyan domain evolutive Ancyloceratidae characterize a constant level of terminal Barremian age; they died out at the same time as most Barremian taxons did, that is at or very near the Barremian-Aptian boundary.

As dominant forms these heteromorphs are replaced by successive representatives of the Deshayesitidae, a family that is characteristic of the lower Aptian. Their evolution permits the subdivision of this substage into four zones.

The last genus of the Deshayesitidae, *i.e.* *Dufrenoyia*, becomes extinct near or slightly after the FAD of *Epicheloniceras*, which has always been considered a Gargasian taxon. The first appearance of *Epicheloniceras* is accompanied by a rich and diverse renewed association that includes various Colombicercatinae and Parahoplitidae.

Numerous species of *Deshayesites*, most of them described in the Turkmenian or Trans-Caspian regions, have been formally identified in the continuous succession of the Lower Aptian at Cassis-La Bédoule: *Paradeshayesites oglanlensis*, *Paradeshayesites planicostatus*, *Paradeshayesites weissiformis*, *D. lupповi*, *D. dechyi*, *D. bogdanovae*, *D. rarecostatus*, *Dufrenoyia sinzovi*, *D. fursovae*.

It is now well-established that in the Lower Aptian stratotype other forms occur, described originally in the Boreal domain and collected from the *Forbesi*, *Deshayesi* and *Bowerbanki* zones of southeastern England (CASEY, 1964). They include *Paradeshayesites callidiscus*, *Deshayesites* sp. gr. *spathi/normani*, *D. formosus*, *Paradeshayesites grandis*, *P. geniculatus*, *D. cf. gracilis*, *Paradeshayesites cf. involutus*, *Dufrenoyia notha*, *D. truncata*, *D. formosa*.

This mixture of Boreal and Tethyan forms at

Cassis-La Bédoule increases the interest of the stratotype even more, for it permits precious correlations between the two domains.

### Acknowledgements

The authors wish to thank Gérard DELANOY (University of Nice-Sophia-Antipolis, France) for his very useful suggestions and indications dealing with *Turkmeniceras* from SE France. They also thank Tamara N. BOGDANOVA (Vsegei, St Petersburg, Russia), Miguel COMPANYY (University of Granada, Spain) and Jaap KLEIN (Natural History Museum, Leiden, the Netherlands), for having led the authors, by their constructive suggestions, to improve the initial manuscript. We are very much indebted to Nestor SANDER for having linguistically upgraded this paper. Special thanks are also due to Valérie MÉNAGE (Agence régionale de l'environnement de Haute-Normandie, Rouen, France) and Robert BUSNARDO (Claude Bernard University, Lyon, France) for providing us with scans of plates from the original d'ORBIGNY's memoirs.

### Bibliographic references

- AGUADO R., COMPANY M., SANDOVAL J. & TAVERA J.M. (1997).- Biostratigraphic events at the Barremian / Aptian boundary in the Betic Cordillera, southern Spain.- *Cretaceous Research*, London, vol. 18, issue 3, pp. 309-329.
- ATROPS F. & DUTOIR Y. (2002).- Nouvelles données biostratigraphiques sur l'Aptien moyen et supérieur du Sud-Est de la France, à la lumière de la succession des ammonites du domaine vocontien. In: 3ème Congrès Français de Stratigraphie, Lyon, 2002.- *Documents des Laboratoires de Géologie Lyon*, n° 156, pp. 23-24.
- AVRAM E. (1999).- The *Deshayesites* KAZANSKY, 1914 (Ammonoidea) representatives in Romania, a link between the West-European and Caspian assemblages of this genus. In: OLÓRIZ F. & RODRIGUEZ-TOVAR F. (eds.), *Advancing Research on Living and Fossil Cephalopods*.- Kluwer Academic/Plenum Press, New York, vol. 30, pp. 437-462.
- BARABOSHKIN E. & MIKHAILOVA I.A. (2002).- New stratigraphical scheme of the lower Aptian of Middle Povolzhie.- *Stratigrafiya, Geologicheskaya Korrelyatsiya* (Stratigraphy and Geological Correlations), Moscow, vol. 10, n° 6, pp. 100-123. ( in Russian)
- BLANC J.-J. (1958).- L'Aptien de La Bédoule (Bouches-du-Rhône). Stratigraphie et sédimentation.- *Bulletin de la Société géologique de France*, Paris, 6<sup>e</sup> série, t. VIII, n° 5, pp. 487-500.
- BARRAGÁN-MANZO R. & MÉNDEZ-FRANCO A.L. (2005).- Towards a standard ammonite zonation for the Aptian (Lower Cretaceous) of northern Mexico.- *Revista Mexicana de Ciencias Geológicas*, Mexico, vol. 22, n° 1, pp. 39-47.
- BOGDANOVA T.N. (1971).- New Barremian ammonites from western Turkmenia.- *Paleontologicheskii zhurnal*, Moscow, n° 3, pp. 60-71; *Paleontological Journal*, Washington, vol. 5, n° 3 (1972), pp. 334-344.
- BOGDANOVA T.N. (1977).- About some *Deshayesites* from western Turkmenia.- *Ezhegodnik Vsesojuznogo Paleontologicheskogo Obshchestva* (Akademiya Nauk SSSR), Leningrad, vol. 19, pp. 46-69. (in Russian)
- BOGDANOVA T.N. (1978).- On zonation of the Lower Aptian of Turkmenia.- *Annual of the All-Union Paleontological Society*, Leningrad, t. 21, pp. 70-81. (in Russian)
- BOGDANOVA T.N. (1979).- Ammonites of the family *Deshayesitidae* of Turkmenia. In: Planktonic and organic world of the pelagic zone in the history of the earth.- *Proceeding of the 19th session of the All-Union Paleontological Society*, Nauka, Leningrad, pp. 152-169. (in Russian)
- BOGDANOVA T.N. (1983).- *Deshayesites tuarkyricus* Zone - The lower zone of the Aptian in Turkmenia.- *Ezhegodnik Vsesojuznogo Paleontologicheskogo Obshchestva* (Akademiya Nauk SSSR), Leningrad, vol. 26, pp. 128-147. (in Russian)
- BOGDANOVA T.N. (1991).- New Lower Aptian ammonite species of Turkmenia.- *Ezhegodnik Vsesojuznogo Paleontologicheskogo Obshchestva* (Akademiya Nauk SSSR), Leningrad, vol. 34, pp. 70-81. (in Russian)
- BOGDANOVA T.N. (1999).- The Lower Aptian of the Mangyshlak Mountains. Stratigraphy and Geological Correlation.- *Stratigrafiya, Geologicheskaya Korrelyatsiya* (Stratigraphy and Geological Correlations), Leningrad, vol. 7, pp. 343-355. (in Russian)
- BOGDANOVA T.N. & MIKHAILOVA I.A. (1999).- Origin and Evolution of the family *Deshayesitidae* (Ammonoidea).- *Paleontological Journal*, Moscow, vol. 33, n° 5, pp. 522-528.
- BOGDANOVA T.N. & MIKHAILOVA I.A. (2004).- Origin, evolution and stratigraphic significance of the Superfamily *Deshayesitaceae* STOYANOW.- *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique*, Bruxelles, vol. 74, pp. 189-243.
- BOGDANOVA T.N. & PROZOROVSKY V.A. (1999).- Substantiation of the Barremian/Aptian boundary.- In: RAWSON P. & HOEDEMAEKER P.J. (eds.), *Proceedings 4th International Workshop of the Lower Cretaceous Cephalopod Team* (IGCP-Project 362).- *Scripta Geologica*, Leiden, Special Issue n° 3, pp. 45-81.
- BOGDANOVA T.N. & TOVBINA S.Z. (1994).- On development of the Aptian Ammonite zonal standard for the Mediterranean Region.- *Géologie Alpine*, Grenoble, Mém. H.S., n° 20, pp. 51-59.
- BOGDANOVA T.N., KVANTALIANI I.V. & SHARIKADZE



- M.Z. (1979).- Some early Aptian Deshayesitidae from central Daghestan.- *Geologica Balcanica*, Sofia, vol. 9, n° 3, pp. 3-12.
- BURCKHARDT R. (1925).- Faunas del Aptiano de Nazas (Durango).- *Boletín del Instituto Geológico de México*, n° 45, 71 p.
- BUSNARDO R. (1984).- Crétacé inférieur: 1.3.1. - Ammonites.- In: DEBRAND-PESSARD S. (ed.), Synthèse Géologique du Sud-Est de la France. I: Stratigraphie et paléogéographie.- *Mémoires du Bureau de Recherches Géologiques et Minières*, Orléans, n° 125, pp. 292-294.
- CASEY R. (1961).- The stratigraphical palaeontology of the Lower Greensand.- *Palaeontology*, London, vol. 3, part 4, pp. 487-621.
- CASEY R. (1964).- The Ammonoidea of the Lower Greensand: Part V.- *Palaeontographical Society Monographs*, London, vol. 117 (1963), pp. 289-398.
- CASEY R. (1980).- The Ammonoidea of the Lower Greensand: Part IX.- *Palaeontographical Society Monographs*, London, vol. 133 (1979), pp. 633-660.
- CASEY R., BAYLISS H.M. & SIMPSON M.I. (1998).- Observations on the lithostratigraphy and ammonite succession of the Aptian (Lower Cretaceous), Lower Greensand of Chale Bay, Isle of Wight, UK.- *Cretaceous Research*, London, vol. 19, issues 3-4, pp. 511-535.
- CECCA F., ROPOLO P. & GONNET R. (1999).- The appearance of the genus *Deshayesites* (KAZANSKY, 1914, Ammonoidea) in the lowermost Aptian (Lower Cretaceous) of La Bédoule (SE France).- *Rivista Italiana di Paleontologia e Stratigrafia*, Milano, vol. 105, n° 2, pp. 267-286.
- CECCA F., ROPOLO P. & GONNET R. (2000).- La base de l'Aptien à Cassis-La Bédoule (SE France). In: MOULLADE M. et alii (eds.), Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- *Géologie méditerranéenne*, Marseille, t. XXV, n° 3-4 (1998), pp. 149-157.
- CONTE G. (1985).- Découverte d'ammonites du Gargasien dans les "Grès et calcaires à Discoïdes et Orbitolines" du synclinal de la Tave (Gard, France).- *Geobios*, Lyon, n° 18, fasc. 2, pp. 203-209.
- CONTE G. (1994).- La limite Bédoulien-Gargasien dans la coupe stratotypique de Cassis (Bouches du Rhône, France).- *Géologie Alpine*, Grenoble, Mém. H.S., n° 20, pp. 231-236.
- CONTE G. (1999).- Éléments de la faune de l'Aptien inférieur (Bédoulien) de Serviers-la-Baume (Gard).- *Bulletin de la Société d'Étude des Sciences Naturelles de Nîmes et du Gard*, vol. 62, pp. 11-15.
- DELANOY G. (1995).- About some significant ammonites from the Lower Aptian (Bedoulian) of the Angle-Barrême area (Southeast France).- *Memorie Descrittive della Carta Geologica d'Italia*, Milano, vol. LI, pp. 65-101.
- DELANOY G., BUSNARDO R., ROPOLO P., GONNET R., CONTE G., MOULLADE M. & MASSE J.-P. (1997).- The 'Pseudocrioceras beds' at La Bédoule (SE France) and the position of the Barremian-Aptian boundary in the historical lower Aptian stratotype.- *Comptes Rendus de l'Académie des Sciences*, Paris, Sciences de la Terre et des Planètes, série IIa, t. 325, n° 8, pp. 593-599.
- DIMITROVA N. (1967).- Fossilite na Bolgaria IV, Dolna Kred. Glavnogi (Nautiloidea i Ammonoidea) [Les fossiles de Bulgarie. IV, Crétacé inférieur; Cephalopoda (Nautiloidea et Ammonoidea)].- Éditions Académie des Sciences de Bulgarie, Sofia, 1236 p. (in Bulgarian with French summary)
- DRUSHCHITS V.V. (1960).- Ammonites.- In: Atlas of the Lower Cretaceous faunas of the northern Caucasus and the Crimea.- *Vsesoyuznyy Nauchno-Issledovatel'skiy Geologicheskii Institut, Trudy*, Moscow, pp. 249-308. (in Russian)
- DRUSHCHITS V.V. & MIKHAILOVA I.A. (1966).- The biostratigraphy of the Lower Cretaceous of the northern Caucasus.- Press of the Moscow University, Moscow, 190 p. (in Russian)
- DRUSHCHITS V.V., MIKHAILOVA I.A. & TKACHUK G.A. (1986).- The central part of the northern slope of the Caucasus.- In: Stratigraphy of the Cretaceous System of the USSR.- Nedra, Moscow, vol. I, pp. 152-160. (in Russian)
- DUTOIR Y. (in press).- Biostratigraphie, évolution et renouvellements des ammonites de l'Aptien supérieur (Gargasien) du bassin vocontien (Sud-Est de la France).- Thèse Université Claude Bernard Lyon 1 (04-11-2005).
- EGOIAN V.L. (1969).- Ammonites from Clansayesian beds of the western Caucasus.- *Krasnodarskiy Filial Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta*, vol. 19, pp. 126-128. (in Russian)
- ERBA E. (1996).- The Aptian stage.- *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique*, Science de la Terre, Bruxelles, vol. 66, pp. 31-43.
- ERISTAVI M.S. (1961).- Aptian and Albian ammonites of the northern Caucasus.- *Geologicheskii Institut, Akademiya Nauk SSSR, Trudy*, Moscow, vol. 12, n° 17, pp. 41-47. (in Russian)
- FABRE-TAXY S., MOULLADE M. & THOMEL G. (1965).- Le Bédoulien dans sa région type, La Bédoule-Cassis (B.-du-R.). In: Colloque sur le Crétacé inférieur (Lyon, septembre 1963).- *Mémoires du Bureau de Recherches Géologiques et Minières*, Orléans, n° 34, pp. 173-199.
- FITTON W. (1836).- Observations on some of the strata between the Chalk and the Oxford Oolite in the South-East of England.- *Transactions of the Geological Society of London*, 2nd ser., vol. IV, 219 p.
- FLANDRIN J. (1965).- Rapport sur l'étage Aptien.



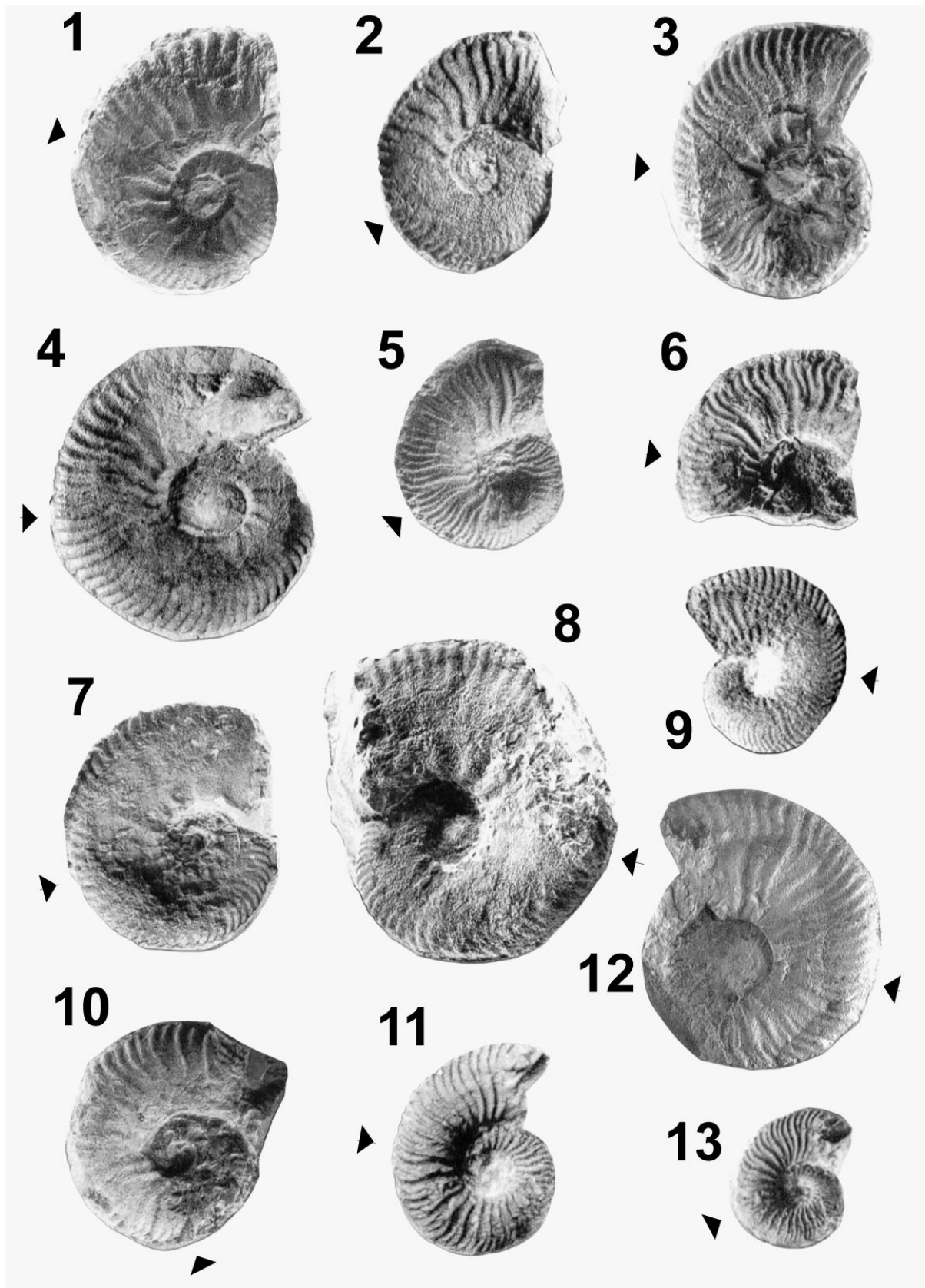
- In: Colloque sur le Crétacé inférieur (Lyon, septembre 1963).- Mémoires du Bureau de Recherches Géologiques et Minières, Orléans, n° 34, pp. 227-234.*
- GLAZUNOVA A.E. (1973).- Paleontological evidence for the stratigraphic subdivision of the Cretaceous in Povolzhie, Lower Cretaceous.- Nedra, Moscow, 324 p. (in Russian)
- GONNET R., ROPOLLO P. & CONTE G. (2000).- Les *Deshayesites* de la zone à *D. tuarkyriscus* dans l'Aptien inférieur de Cassis-La Bédoule (SE France). *In: MOULLADE M. et alii* (eds.), Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- *Géologie méditerranéenne*, Marseille, t. XXV, n° 3-4 (1998), pp. 125-147.
- HÉBERT E. (1871).- Le Néocomien inférieur dans le midi de la France (Drôme et Basses-Alpes).- *Bulletin de la Société géologique de France*, Paris, 2<sup>e</sup> série, t. XXVIII, pp. 137-170.
- HOEDEMAEKER P.J. (2004).- On the Barremian - Lower Albian stratigraphy of Colombia- *Scripta Geologica*, Leiden, vol. 128, pp. 3-15.
- HOEDEMAEKER P.J. & BULOT L. (1990).- Preliminary ammonite zonation for the Lower Cretaceous of the Mediterranean Region.- *Géologie Alpine*, Grenoble, vol. 66, pp. 123-127.
- HOEDEMAEKER P.J. & RAWSON P.F. (2000).- Report on the 5th International Workshop of the Lower Cretaceous Cephalopod Team (Vienna, 5 September 2000).- *Cretaceous Research*, London, vol. 21, issue 6, pp. 857-860.
- HOEDEMAEKER P.J., REBOULET S. (coords.), AGUIRRE-URRETA M.B., ALSEN P., AOUTEM M., ATROPS F., BARRAGÁN R., COMPANY M., GONZÁLEZ C., KLEIN J., LUKENEDER A., PLOCH I., RAISOSSADAT N., RAWSON P.F., ROPOLLO P., VAŠIČEK Z., VERMEULEN J. & WIPPICH M.G.E. (2003).- Report on the 1st International Workshop of the IUGS Lower Cretaceous Ammonite Working Group, the 'KILIAN Group' (Lyon, 11 July 2002).- *Cretaceous Research*, London, vol. 24, issue 1, pp. 89-94.
- JACOB C. (1907).- Études paléontologiques et stratigraphiques sur la partie moyenne des terrains crétacés dans les Alpes françaises et les régions voisines.- *Annales de l'Université de Grenoble*, vol. 19, n° 2, pp. 221-534.
- KAKABADZE M.V. (1981).- Ancyloceratidae of the South of the USSR and their stratigraphical significance.- *Geologicheskii Institut, Akademiya Nauk SSSR, Trudy*, Moscow, NS, vol. 71, 197 p. (in Russian)
- KAKABADZE M.V. (2004).- Intraspecific and intrageneric variabilities and their implication for the systematics of the Cretaceous heteromorph ammonites; a review.- *Scripta Geologica*, Leiden, vol. 128, pp. 17-37.
- KAKABADZE M.V. & KOTETISHVILI E.V. (1995).- New data on the Upper Barremian biostratigraphy of the Georgian Region (Caucasus).- *Memorie Descrittive della Carta Geologica d'Italia*, Milano, vol. LI, pp. 103-108.
- KAKABADZE M.V., BOGDANOVA T.N. & MIKHAILOVA I.A. (1978).- On the stratigraphy of the Aptian of the south USSR and some heteromorph ammonites.- *Moskovskoye Obshchestvo Ispytateley Prirody (MOIP), Byulleten', Otdel Geologicheskii*, Moscow, vol. 53, pp. 75-90. (in Russian)
- KARAKASCH N.I. (1907).- The Lower Cretaceous of the Crimea and its fauna.- *Travaux de la Société Impériale des Naturalistes de St.-Petersbourg*, Section de Géologie et de Minéralogie, vol. XXXII, livre 5, 482 p. (in Russian)
- KEMPER E. (1971).- Zur Gliderung und Abgrenzung des norddeutschen Aptium mit Ammoniten.- *Geologisches Jahrbuch*, Hannover, Band 89, pp. 359-390.
- KEMPER E. (ed.) (1982).- Das späte Apt und frühe Alb Nordwestdeutschland, Versuch der umfassenden Analyse einer Schichtenfolge.- *Geologisches Jahrbuch*, Hannover, Reihe A, Heft 65, 703 p.
- KILIAN W. (1910).- Das bathyale Palaeocretacium im südöstlichen Frankreich. *Lethaea geognostica*, pt. 2, Das Mesozoicum. Vol. 3, Kreide. Sect. 1, fasc. 2d, Unterkreide.- Stuttgart, 398 p.
- KILIAN W. & REBOUL P. (1915).- La faune de l'Aptien inférieur des environs de Montélimar (Carrière de l'Homme d'Armes, Drôme). *In: KILIAN W. (ed.)*, Contribution à l'étude des faunes paléocrétacées du Sud-Est de la France.- *Mémoires pour servir à l'Explication de la Carte géologique détaillée de la France*, Paris, n° 14, 221 p.
- KOENEN A. von (1902).- Die Ammonitiden des Norddeutschen Neocom (Valanginien, Hauterivien, Barrémien und Aptien).- *Abhandlungen der Königlich Preußischen Geologischen Landesanstalt und Bergakademie*, N.F., Heft 24, 451 p.
- KOTETISHVILI E.V. (1986).- Zonal stratigraphy of the Lower Cretaceous deposits of Georgia and paleobiogeography of the Early Cretaceous basins of the Mediterranean region.- *Trudy Geologicheskogo Instituta Akademii Nauk SSSR*, Moscow, NS, vol. 91, 160 p. (in Russian)
- LUPPOV N.P. (1952).- Lower Cretaceous deposits of the Northwestern Caucasus and their fossils.- *Trudy Vsesojuznogo Neftjanogo Nauchno-Issledovatel'skogo Geologo-Razvedochnogo Instituta*, Leningrad, NS, vol. 65, 238 p. (in Russian)
- LUPPOV N.P., BODYLEVSKY V.I. & GLAZUNOVA A.E. (1949).- Klass Cephalopoda. Golovonogie. [Class Cephalopoda]. *In: LUPPOV N.P. (ed.)*, Atlas of index forms of the fossil faunas of the USSR. 10. Lower Cretaceous.- *Gosgeolizdat*, Moscow, pp. 183-253. (in Russian)
- MASSE J.-P. (1998).- Sédimentologie du stratotype historique de l'Aptien inférieur

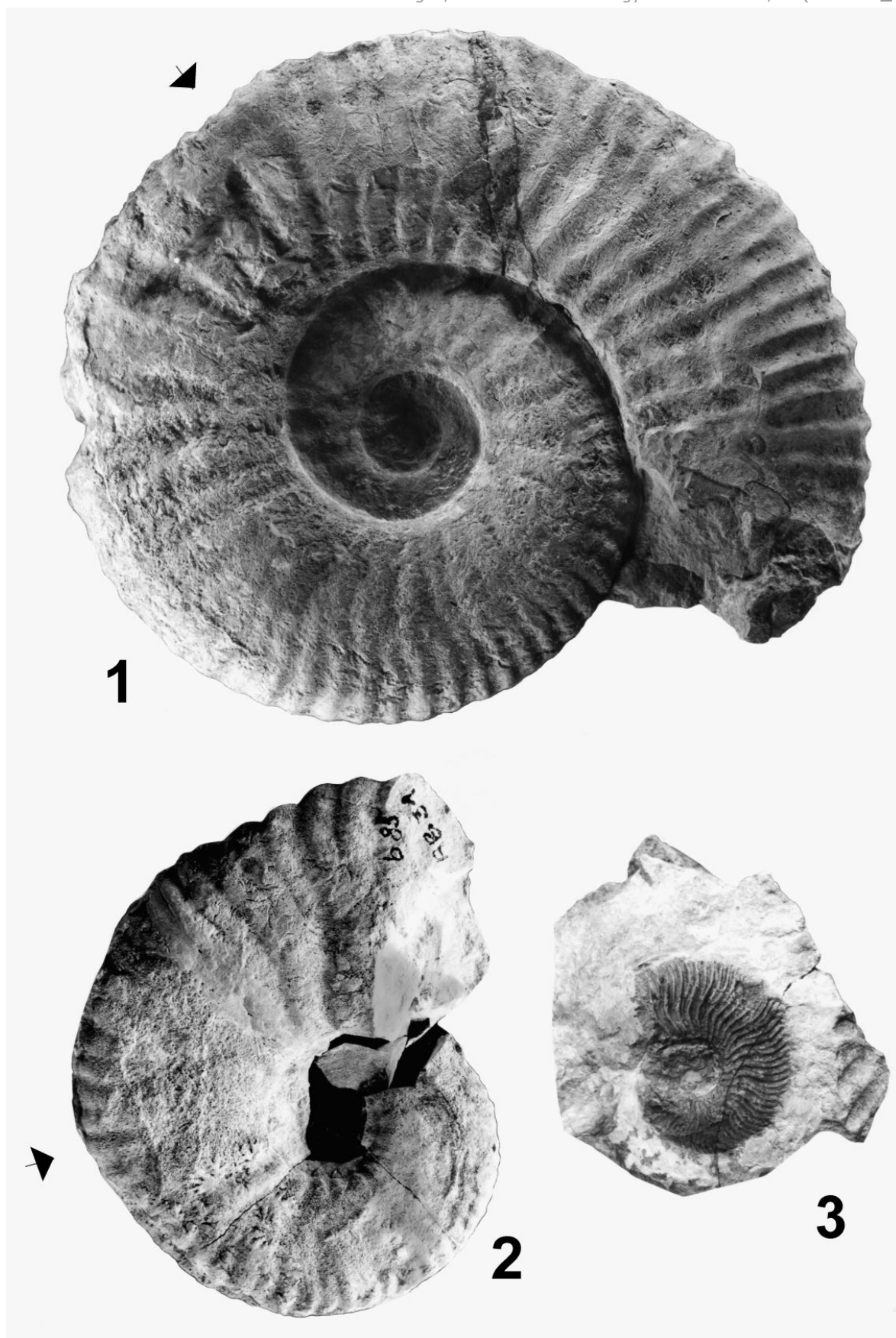
- dans la région de Cassis - La Bédoule (SE France). In: MOULLADE M. *et alii* (eds.), Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- *Géologie méditerranéenne*, Marseille, t. XXV, n° 3-4 (1998), pp. 31-41.
- MATHERON P. (1842-1843).- Catalogue méthodique et descriptif des corps organisés fossiles du département des Bouches-du-Rhône et lieux circonvoisins.- *Répertoire des Travaux de la Société de Statistique de Marseille*, vol. VI ; Carnaud Fils, Marseille, 269 p.
- MATHERON P. (1878-1880).- Recherches paléontologiques dans le Midi de la France.- 10 et 15 parties, pp. 1-8 & 1-4.
- MIKHAILOVA I.A. (1983).- System and phylogeny of Cretaceous ammonoidea.- Nauka, Moskva, 280 p. (in Russian)
- MOULLADE M., TAXY S. & TRONCHETTI G. (1980).- Bédoulien. In: CAVELIER C. & ROGER J. (eds.), Les étages français et leurs stratotypes.- *Mémoires du Bureau de Recherches Géologiques et Minières*, Orléans, n° 109, pp. 116-119.
- MOULLADE M., KUHNT W., BERGEN J.A., MASSE J.-P. & TRONCHETTI G. (1998).- Correlation of biostratigraphic and stable isotope events in the Aptian historical stratotype of La Bédoule (southeast France).- *Comptes Rendus de l'Académie des Sciences*, Paris, Sciences de la Terre et des Planètes, série IIa, t. 327, n° 10, pp. 693-698.
- MOULLADE M., TRONCHETTI G. & MASSE J.P. (eds.) (2000a).- Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- *Géologie méditerranéenne*, Marseille, t. XXV, n° 3-4 (1998), 298 p.
- MOULLADE M., TRONCHETTI G., BUSNARDO R. & MASSE J.-P. (2000b).- Description lithologique des coupes types du stratotype historique de l'Aptien inférieur dans la région de Cassis-La Bédoule (SE France). In: MOULLADE M. *et alii* (eds.), Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- *Géologie méditerranéenne*, Marseille, t. XXV, n° 3-4 (1998), pp. 15-29.
- MOULLADE M., MASSE J.-P., TRONCHETTI G., KUHNT W., ROPOLO P., BERGEN J.A., MASURE E. & RENARD M. (2000c).- Le stratotype historique de l'Aptien (région de Cassis-La Bédoule, SE France): synthèse stratigraphique. In: MOULLADE M. *et alii* (eds.), Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- *Géologie méditerranéenne*, Marseille, t. XXV, n° 3-4 (1998), pp. 289-298.
- MOULLADE M., TRONCHETTI G. & BELLIER J.-P. (2005).- The Gargasian (Middle Aptian) strata from Cassis-La Bédoule (Lower Aptian historical stratotype, SE France): planktonic and benthic foraminiferal assemblages and biostratigraphy.- *Carnets de Géologie*, Brest, Article 2005/02 (CG2005\_A02), 20 p.
- NEUMAYR M. & UHLIG V. (1881).- Ueber Ammonitiden aus den Hilsbildungen Norddeutschlands.- *Palaeontographica*, Cassel, vol. 27, pp. 129-203.
- ORBIGNY A. d' (1840).- Paléontologie française. Description zoologique et géologique de tous les animaux mollusques et rayonnés fossiles de la France - Tome Premier. Terrains crétacés.- Paris, 662 p., Atlas: Pl. 1-148. (1st edition)
- ORBIGNY A. d' (1840-1841).- Paléontologie française. Description des mollusques et rayonnés fossiles - Terrains crétacés. Tome Premier. Céphalopodes.- Masson, Paris, 662 p., Pl. 1-148. (definitive edition)
- PAPP K. (1907).- Beschreibung der während der Forschungsreisen M. v. DÉCHY im Kaukasus gesammelten Versteinerungen. III. In: DÉCHY M. von (ed.), Kaukasus. Reisen und Forschungen im kaukasischen Hochgebirge.- Berlin, pp. 141-174.
- PEYBERNÈS B. (1976).- Le Jurassique et le Crétacé inférieur des Pyrénées franco-espagnoles entre la Garonne et la Méditerranée.- Thèse de Doctorat ès Sciences naturelles, Université Paul Sabatier, Toulouse, 459 p.
- QUENSTEDT F.A. (1845-1849).- Petrefactenkunde Deutschlands, 1. Abteilung, 1. Band, Die Cephalopoden.- Ludwig Friedrich Fues, Tübingen, 580 p.
- RAISOSSADAT S.N. (2004).- The ammonite family Deshayesitidae in the Kopet Dag Basin, north-east Iran.- *Cretaceous Research*, London, vol. 25, issue 1, pp. 115-136.
- RENARD M. & RAFELIS M. de (1998).- Géochimie des éléments traces de la phase carbonatée des calcaires de la coupe du stratotype historique de l'Aptien inférieur dans la région de Cassis-La Bédoule (SE France).- In: MOULLADE M. *et alii* (eds.), Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- *Géologie méditerranéenne*, Marseille, t. XXV, n° 3-4 (1998), pp. 43-54.
- RENNGARTEN V. (1926).- La faune des dépôts crétacés de la région d'Assa-Kambileevka, Caucase du Nord.- *Trudy Geologicheskogo Komiteta* [Mémoires du Comité Géologique], St. Petersburg, N.S., tom 147, 132 p. (in Russian)
- REYNÈS P. (1861).- Essai sur le synchronisme et la délimitation des terrains crétacés du Sud-Est de la France.- *Mémoires de la Société d'Émulation de Provence*, Marseille, n° 1, pp. 5-115.
- ROCH É. (1927).- Étude stratigraphique et paléontologique de l'Aptien inférieur de La Bédoule, près Cassis (B.-du-Rh.).- *Mémoires de la Société Géologique de France*, Paris, NS, t. IV, n° 8, 37 p.
- ROMAN F. (1938).- Les Ammonites jurassiques et crétacées.- Masson, Paris, 554 p.
- ROPOLO P., CECCA F. & GONNET R. (2000a).- The

- stratigraphic position of "*Ammonites consobrinus*" d'ORBIGNY (Deshayesitidae, Ammonoidea) in the Lower Aptian of Cassis-La Bédoule (SE France).- *In*: MOULLADE M. *et alii* (eds.), Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- *Géologie méditerranéenne*, Marseille, t. XXV, n° 3-4 (1998), pp. 159-165.
- ROPOLO P., CONTE G., GONNET R., MASSE J.-P. & MOULLADE M. (2000b).- Les faunes d'Ammonites du Barrémien supérieur/Aptien inférieur (Bédoulien) dans la région stratotypique de Cassis-La Bédoule (SE France) : état des connaissances et propositions pour une zonation par Ammonites du Bédoulien-type.- *In*: MOULLADE M. *et alii* (eds.), Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- *Géologie méditerranéenne*, Marseille, t. XXV, n° 3-4 (1998), pp. 167-175.
- ROPOLO P., GONNET R. & CONTE G. (2000c).- Le genre *Pseudocrioceras* dans les couches de passage du Barrémien supérieur/Bédoulien inférieur de Cassis-La Bédoule (SE France).- *In*: MOULLADE M. *et alii* (eds.), Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- *Géologie méditerranéenne*, Marseille, t. XXV, n° 3-4 (1998), pp. 85-123.
- ROPOLO P. & GONNET R. (1999).- A propos de quelques Ancyloceratidae nouveaux ou peu connus du Barrémien sommital de la Bédoule (B. du Rh. - France) : position stratigraphique et systématique.- *Géologie méditerranéenne*, Marseille, t. XXV, n° 2 (1998), pp. 117-143.
- ROPOLO P. & GONNET R. (2003).- Les *Dufrenoyia* (Ammonoidea) de la Zone à *Furcata* (Aptien inférieur) du Sud-Est de la France.- *Annales du Muséum d'Histoire Naturelle de Nice*, vol. 18, pp. 21-57.
- ROPOLO P., GONNET R. & CONTE G. (1999).- The '*Pseudocrioceras* interval' and adjacent beds at La Bédoule (SE France): implications to highest Barremian/lowest Aptian biostratigraphy.- *Scripta Geologica*, Leiden, Special Issue 3, pp. 159-213.
- ROPOLO P. & MOULLADE M. (2002).- L'Aptien, ses sous-étages et stratotypes historiques: à propos du Gargasien de la région d'Apt (Vaucluse, SE de la France).- Colloque du Bicentenaire de la naissance d'Alcide d'ORBIGNY (1802-2002), Excursion dans le Sud-Est de la France.- Muséum National d'Histoire Naturelle, Paris, 5 p.
- SARASIN C. (1897).- Quelques considérations sur les genres *Hoplites*, *Sonneratia*, *Desmoceras* et *Puzosia*.- *Bulletin de la Société géologique de France*, Paris, 3<sup>e</sup> série, t. XXV, pp. 760-799.
- SPATH L.F. (1930).- On some ammonoidea from the lower Greensand.- *Annals and Magazine of Natural History*, London, 10th Series, 5, pp. 417-464.
- THOMEL G. (1980).- Ammonites.- Serre Édit., Nice, 227 p.
- TOUCAS A. (1888).- Note sur le Jurassique supérieur et le Crétacé inférieur de la Vallée du Rhône.- *Bulletin de la Société géologique de France*, Paris, 3<sup>e</sup> série, t. XVI, pp. 903-927.
- VAŠIČEK E. & SUMMESBERGER H. (2004).- Ammonoids from the Aptian (Lower Cretaceous, Upper Austria) of the Northern Calcareous Alps.- *Annalen des Naturhistorisches Museums in Wien*, vol. 106A, pp. 53-65.
- WRIGHT C.W. (1957).- Mesozoic Ammonoidea; Cretaceous Systematic Descriptions. *In*: ARKELL W.J., KUMMEL B. & WRIGHT C.W. (eds.), Treatise on Invertebrate Paleontology. Part L: Mollusca 4, Cephalopoda, Ammonoidea.- Geological Society of America, New York, & University of Kansas Press, Lawrence, 490 p.

# Plate 1: ►

- Fig. 1.-** *Deshayesites luppovi* (BOGDANOVA, 1991) (ABR32), Le Brigadan section, bed 61. *P. ogranlensis* Zone.
- Fig. 2.-** *Deshayesites luppovi* BOGDANOVA, 1983) (ABR279), Les Caniers section, bed 65. *P. ogranlensis* Zone.
- Fig. 3.-** *Paradeshayesites ogranlensis* (BOGDANOVA, 1983) (ABR271), Le Brigadan section, bed 63, *P. ogranlensis* Zone.
- Fig. 4.-** *Deshayesites luppovi* BOGDANOVA, 1983 (ABR285), Les Caniers section, bed 72. *P. ogranlensis* Zone.
- Fig. 5.-** *Paradeshayesites weissiformis* (BOGDANOVA, 1983) (ABR272), Le Brigadan section, bed 64. *P. ogranlensis* Zone
- Fig. 6.-** *Paradeshayesites weissiformis* (BOGDANOVA, 1983) (ABR278), Les Caniers section, bed 82. *P. ogranlensis* Zone
- Fig. 7.-** *Paradeshayesites* sp. aff. *planicostatus* (BOGDANOVA, 1991) (ABR33), Les Caniers section, bed 63. *P. ogranlensis* Zone.
- Fig. 8.-** *Paradeshayesites* sp. aff. *planicostatus* (BOGDANOVA, 1991) (ABR301), Les Caniers section, bed 67. *P. ogranlensis* Zone.
- Fig. 9.-** *Paradeshayesites* sp. (ABR35), Le Brigadan section, bed 63. *P. ogranlensis* Zone.
- Fig. 10.-** *Paradeshayesites* sp. aff. *planicostatus* (BOGDANOVA, 1991) (ABR282), Les Caniers section, bed 82. *P. ogranlensis* Zone.
- Fig. 11.-** *Paradeshayesites ogranlensis* (BOGDANOVA, 1983) (ABR281), Les Caniers section, bed 78. *P. ogranlensis* Zone.
- Fig. 12.-** *Deshayesites luppovi* BOGDANOVA, 1983 (ABR36), Les Caniers section, bed 78. *P. ogranlensis* Zone.
- Fig. 13.-** *Paradeshayesites ogranlensis* (BOGDANOVA, 1983) (ABR30), Le Brigadan section, bed 63. *P. ogranlensis* Zone.





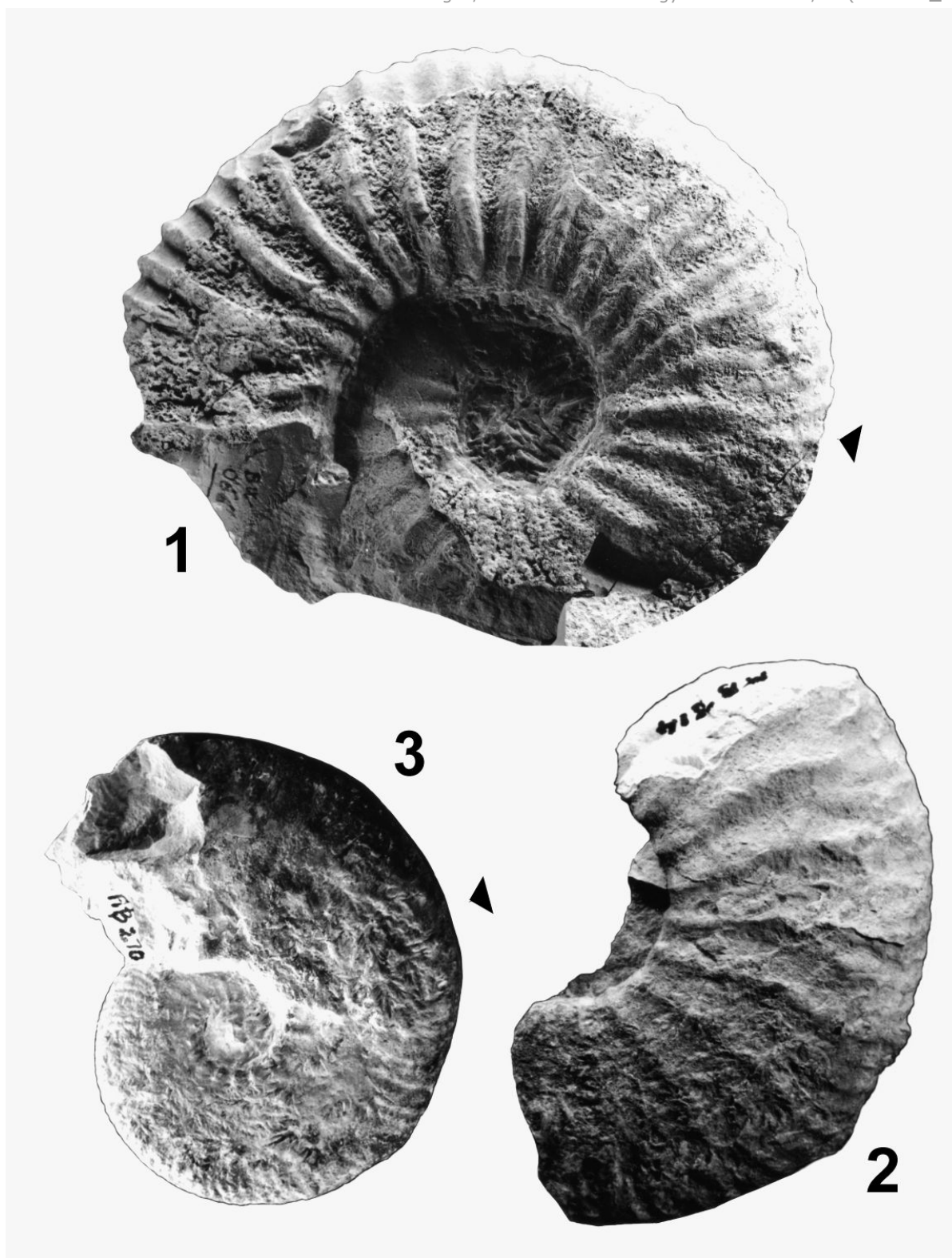
**Plate 2:**

**Fig. 1.-** *Deshayesites bedouliensis* CECCA, ROPOLLO et GONNET, 1999 (BW112), Le Brigadan section, bed 61. *P. oglanlensis* Zone.

**Fig. 2.-** *Deshayesites bedouliensis* CECCA, ROPOLLO et GONNET, 1999 (BW021), Les Caniers section, bed 61. *P. oglanlensis* Zone.

**Fig. 3.-** *Paradeshayesites weissiformis* (BOGDANOVA, 1983) (BW003), Les Caniers section, bed 64. *P. oglanlensis* Zone.





**Plate 3:**

**Fig. 1.-** *Deshayesites* sp. aff. *consobrinus* (d'ORBIGNY, 1841) (BW066), Le Brigadan section, bed 62. *P. oylanensis* Zone.

**Fig. 2.-** *Deshayesites bedouliensis* CECCA, ROPOLLO et GONNET, 1999 (BW270), Le Brigadan section, bed 62. *P. oylanensis* Zone.

**Fig. 3.-** *Deshayesites bedouliensis* CECCA, ROPOLLO et GONNET, 1999 (BW014), Highway A. 52 section, bed 61. *P. oylanensis* Zone.





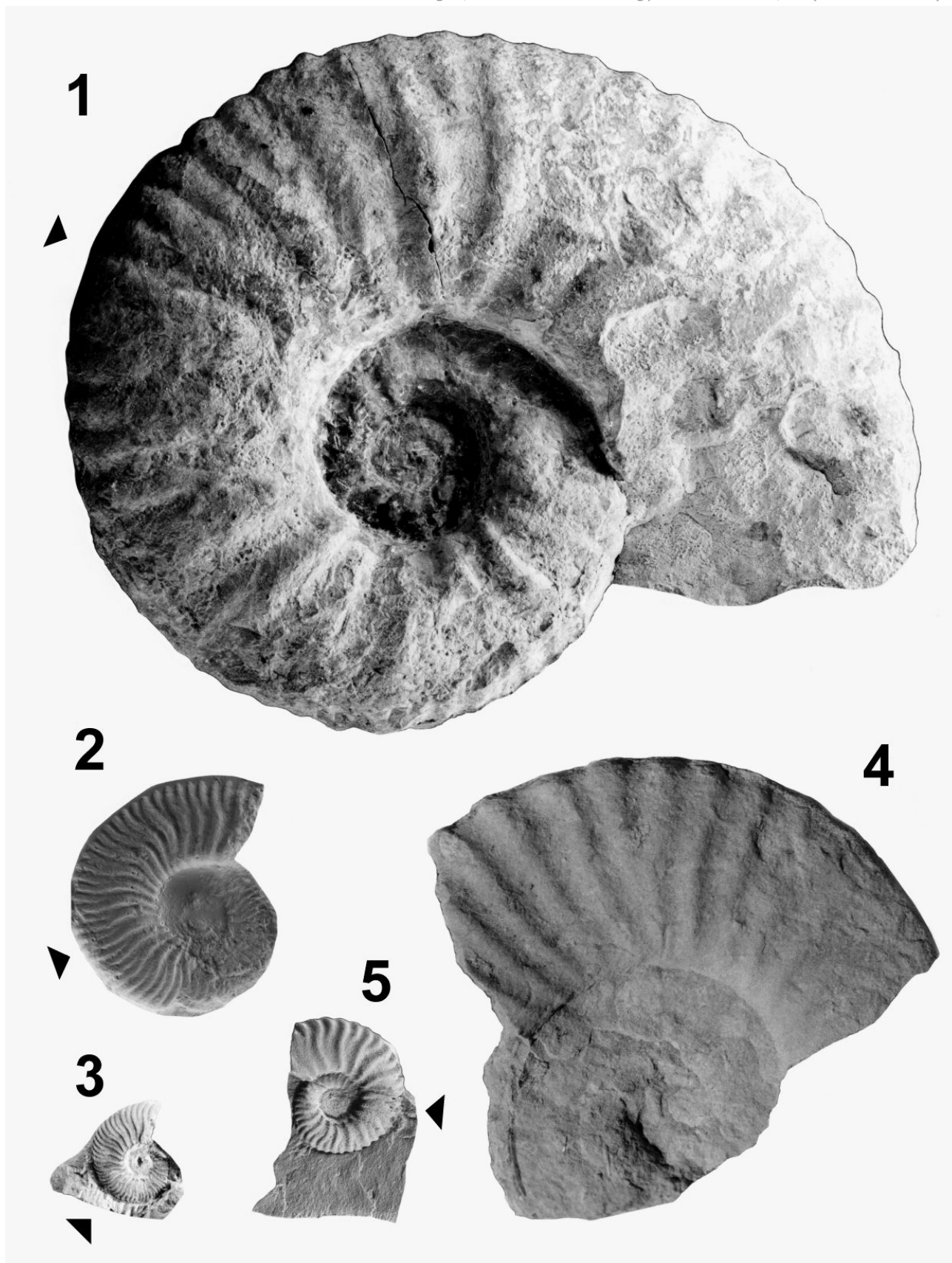
**Plate 4:**

**Fig. 1.-** *Deshayesites* sp. aff. *luppovi* (macroconch?) BOGDANOVA, 1983 (ABR279), Les Caniers section, bed 72. *P. oglanlensis* Zone.

**Fig. 2.-** *Paradeshayesites callidiscus* (CASEY, 1961) var. *rugosus* (CASEY, 1964) (ABR388), Les Fourniers section, bed 110. *P. weissi* Zone.

**Fig. 3.-** *Deshayesites dechyi* PAPP, 1907 (ABR46), Les Fourniers section, bed 125. *P. weissi* Zone.

**Fig. 4.-** *Paradeshayesites weissi* (NEUMAYR et UHLIG, 1881) (ABR289), Les Fourniers section, bed 110. *P. weissi* Zone.



**Plate 5:**

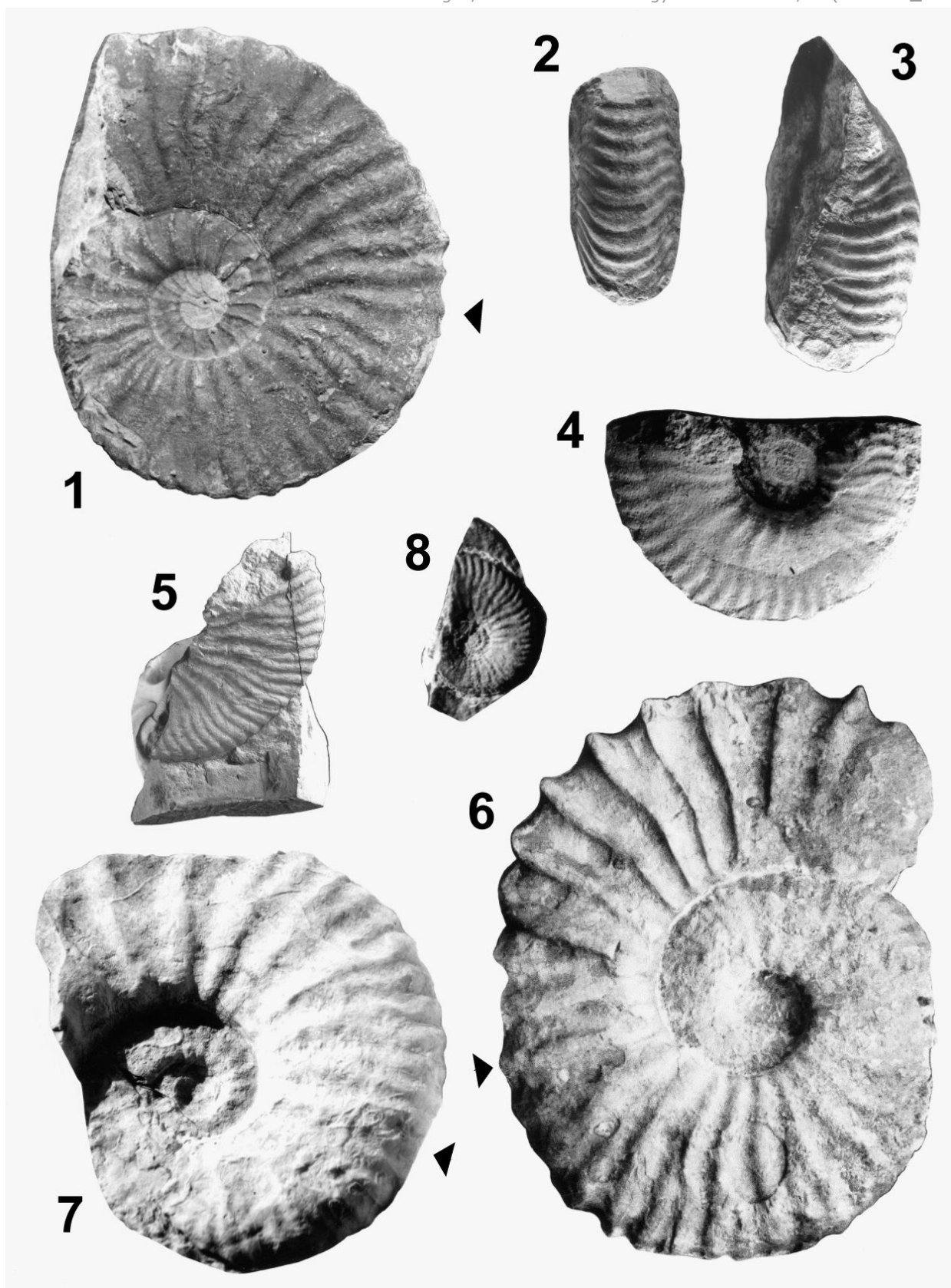
**Fig. 1.-** *Deshayesites* gr. *spathi/normani* CASEY, 1964 (ABR323), Les Fourniers section, bed 111. *P. weissi* Zone.

**Fig. 2.-** *Deshayesites dechyi* PAPP, 1907 (ABR502), Les Fourniers section, bed 125. *P. weissi* Zone.

**Fig. 3.-** *Deshayesites planus* CASEY, 1964 (ABR321), Les Fourniers section, bed 116. *P. weissi* Zone.

**Fig. 4.-** *Deshayesites evolvens* LUPPOV, 1952 (ABR489), Les Fourniers section, bed 115. *P. weissi* Zone.

**Fig. 5.-** *Deshayesites euglyphus* CASEY, 1964 (ABR500), Les Fourniers section, bed 112. *P. weissi* Zone.



**Plate 6:**

**Fig. 1.-** *Deshayesites consobrinus* (d'ORBIGNY, 1841) (BW076), Les Fourniers section, bed 115. *P. weissi* Zone.

**Figs. 2 & 3.-** *Deshayesites forbesi* CASEY, 1961 (ABR42 a & b), Les Fourniers section, bed 117. *P. weissi* Zone.

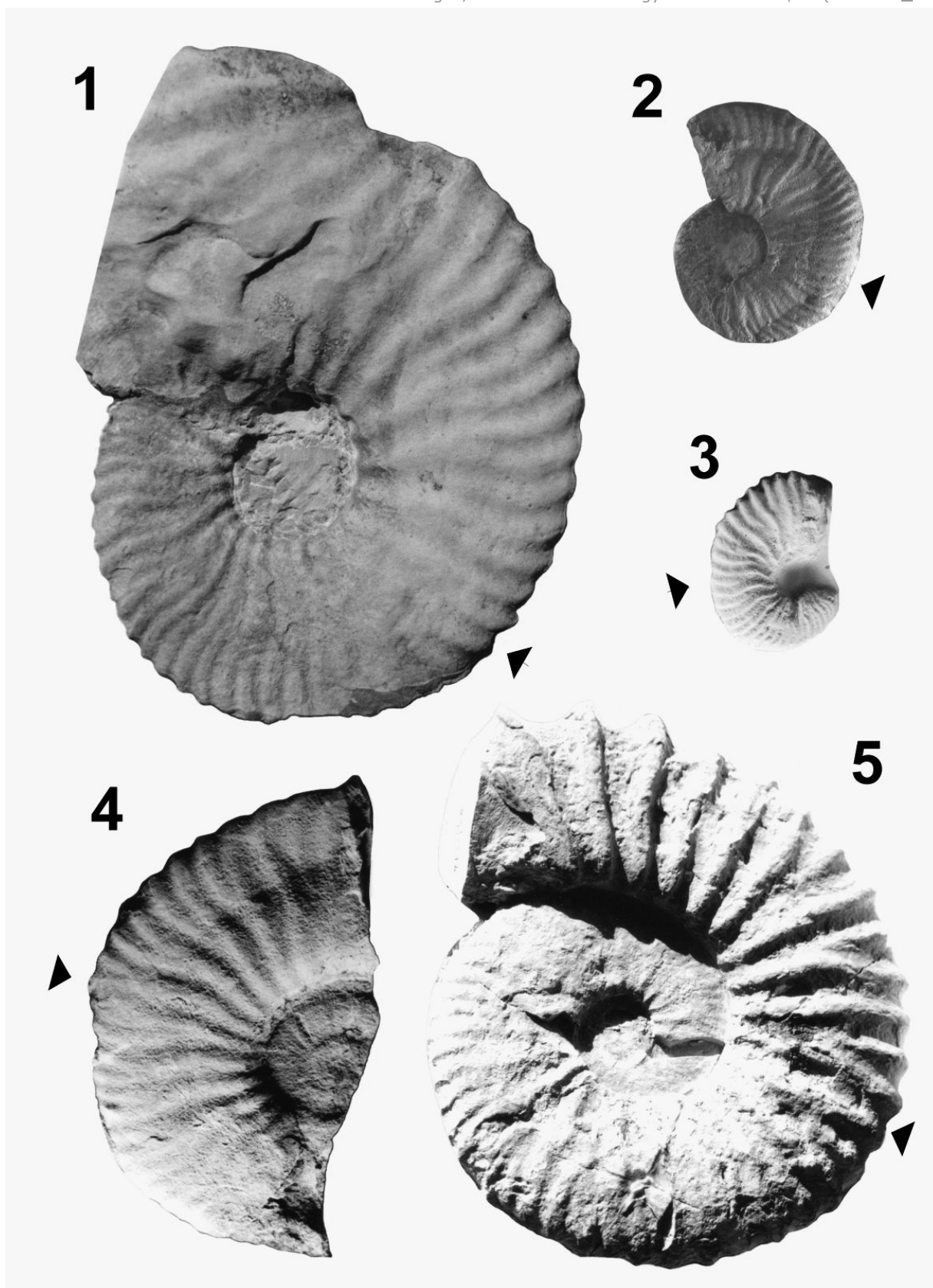
**Fig. 4.-** *Deshayesites forbesi* CASEY, 1961 (ABR47), Les Fourniers section, bed 117. *P. weissi* Zone.

**Fig. 5.-** *Paradeshayesites weissi* (NEUMAYR et UHLIG, 1881) (ABR50), Les Fourniers section, bed 113. *P. weissi* Zone.

**Fig. 6.-** *Deshayesites consobrinus* (d'ORBIGNY, 1841) (ABR278), Les Fourniers section, bed 115. *P. weissi* Zone.

**Fig. 7.-** *Deshayesites euglyphus* CASEY, 1964 (ABR490), Les Fourniers section, bed 120 *P. weissi* Zone.

**Fig. 8.-** *Paradeshayesites weissi* (NEUMAYR et UHLIG, 1881) (ABR016), Les Fourniers section, bed 113. *P. weissi* Zone.



**Plate 7:**

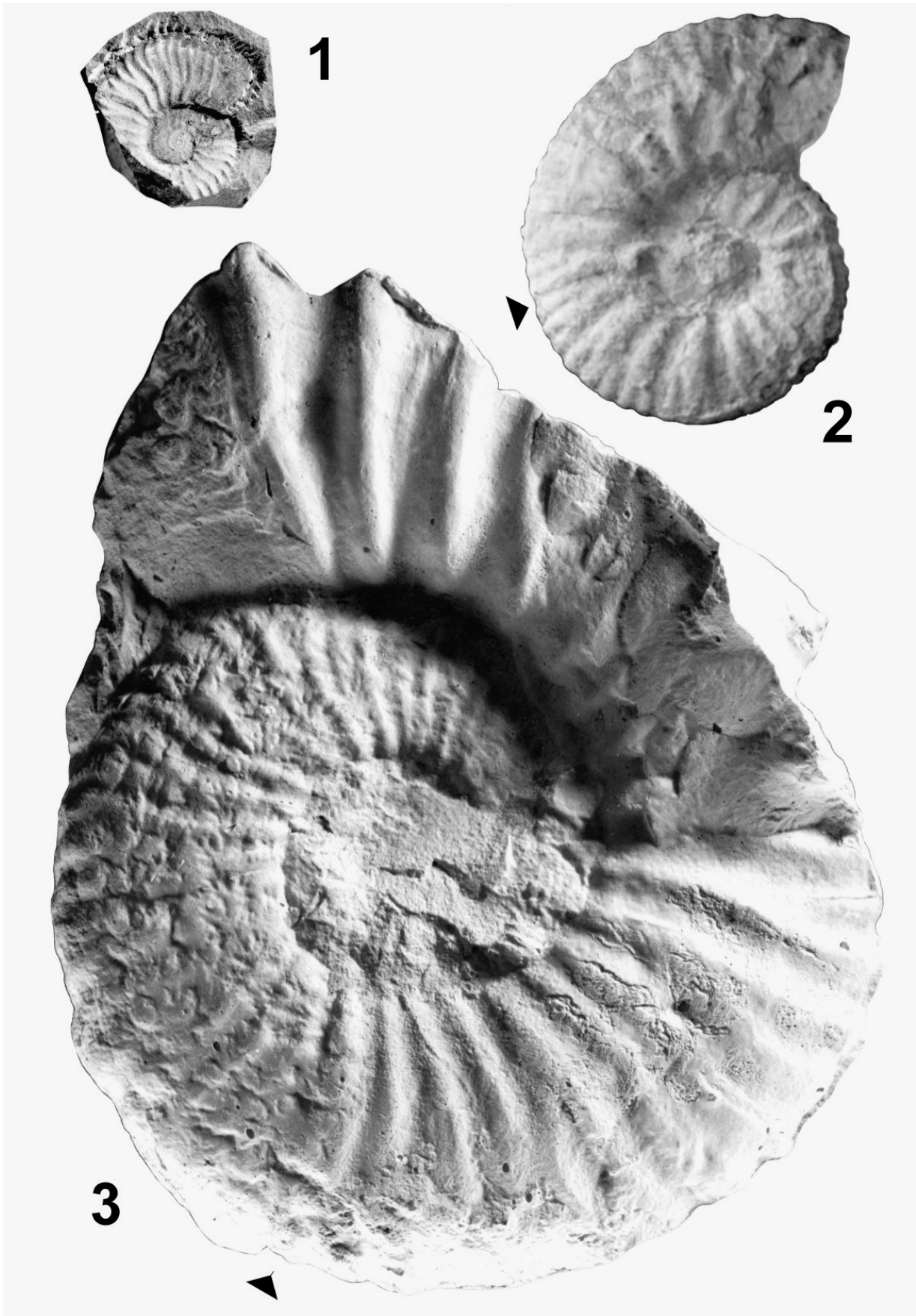
**Fig. 1.-** *Paradeshayesites callidiscus* (CASEY, 1961) var. *rugosus* (CASEY, 1964) (ABR43), Les Fourniers section, bed 119. *P. weissi* Zone.

**Fig. 2.-** *Paradeshayesites weissi* (NEUMAYR et UHLIG, 1881) (ABR29), Les Fourniers section, bed 113. *P. weissi* Zone.

**Fig. 3.-** *Deshayesites* cf. *dechyi* PAPP, 1907 (ABR501), Les Fourniers section, bed 137. *P. weissi* Zone.

**Fig. 4.-** *Deshayesites forbesi* CASEY, 1961 (ABR318), Les Fourniers section, bed 117. *P. weissi* Zone.

**Fig. 5.-** *Deshayesites consobrinus* (d'ORBIGNY, 1841) (SCP4), Les Fourniers section, bed 127. *P. weissi* Zone.



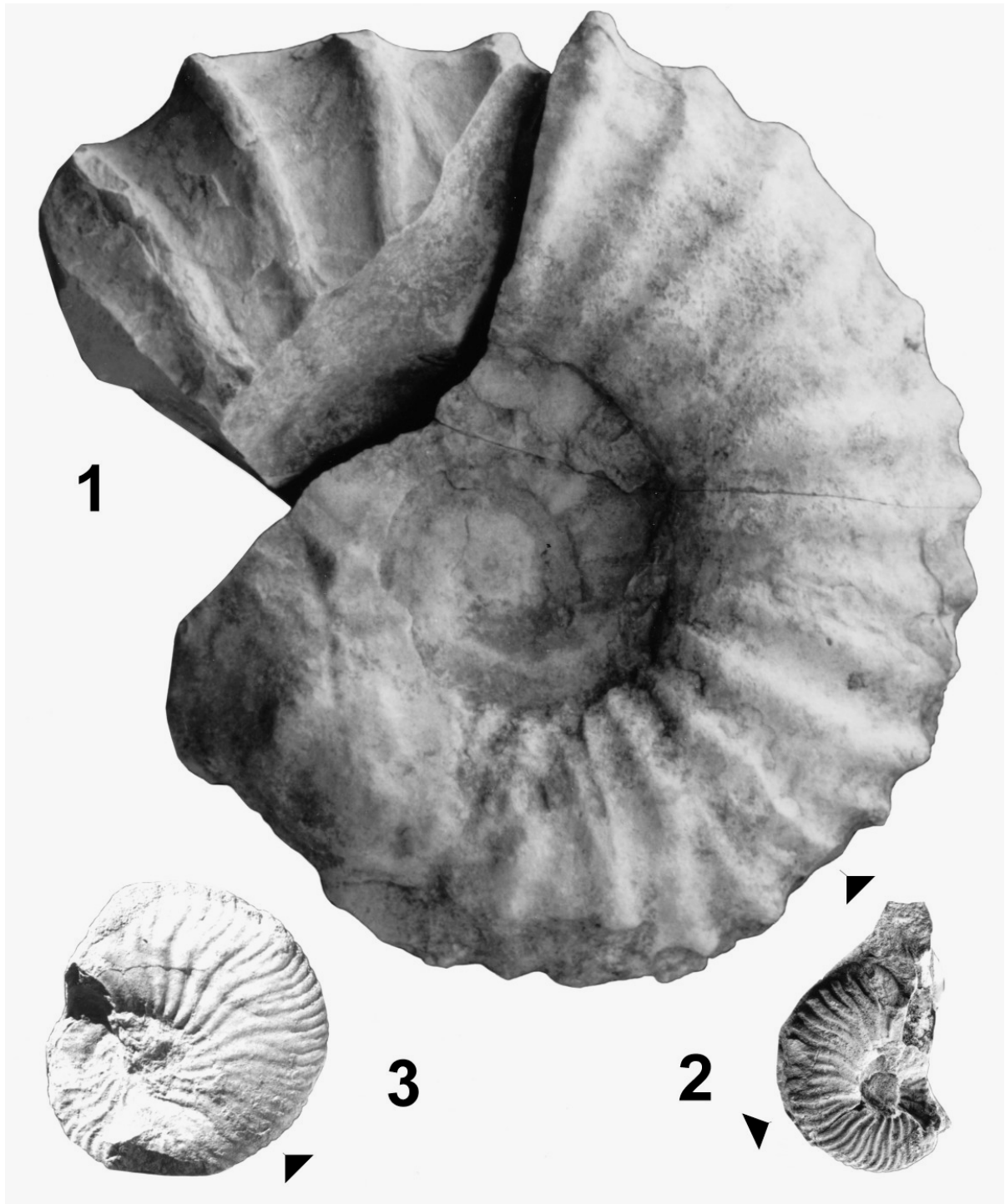
**Plate 8:**

**Fig. 1.-** *Deshayesites dechyi* PAPP, 1907 (ABR14), Les Fourniers section, bed 138c. *D. deshayesi* Zone.

**Fig. 2.-** *Deshayesites evolvens* LUPPOV, 1952 (Abm311), Les Fourniers section, bed 115. *P. weissii* Zone.

**Fig. 3.-** *Deshayesites* sp. gr. *spathi/normani* CASEY, 1964 (ABR340), Les Fourniers section, bed 111. *P. weissii* Zone.



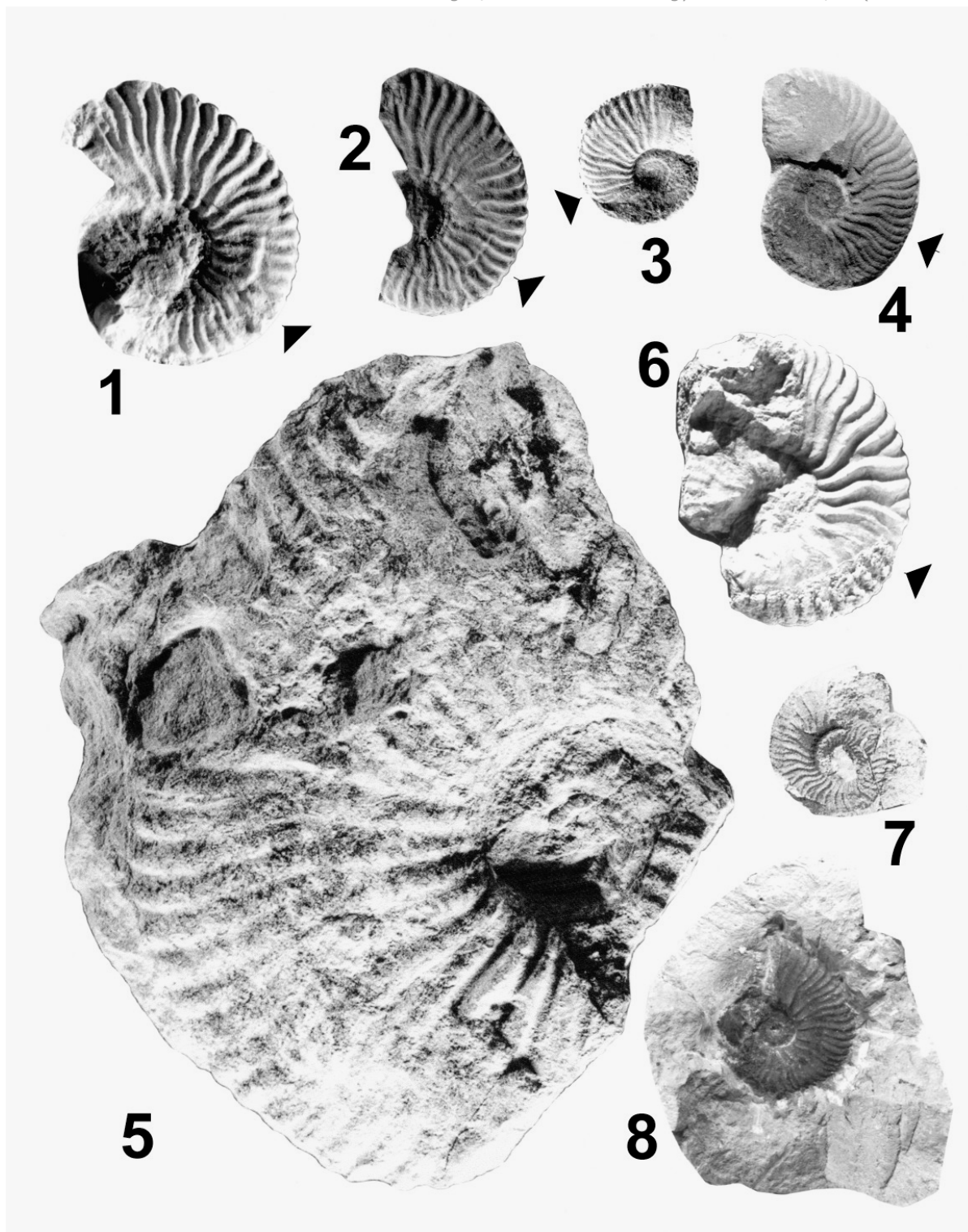


**Plate 9:**

**Fig. 1.-** *Deshayesites* sp. gr. *spathi/normani* CASEY, 1964 (RG342), Les Fourniers section, bed 126. *P. weissii* Zone.

**Fig. 2.-** *Paradeshayesites* cf. *involutus* (SPATH, 1930) (RG325), Les Fourniers section, bed 165. *D. deshayesi* Zone.

**Fig. 3.-** *Deshayesites* cf. *planus* CASEY, 1964 (ABR362), Les Fourniers section, bed 122. *P. weissii* Zone.



**Plate 10:**

**Fig. 1.-** *Deshayesites deshayesi* (LEYMERIE, 1841) (ABR512), Zone Les Fourniers section, bed 130. *D. deshayesi* Zone.

**Fig. 2.-** *Deshayesites deshayesi* (LEYMERIE, 1841) (ABR511), Les Fourniers section, bed 135. *D. deshayesi* Zone.

**Fig. 3.-** *Paradeshayesites grandis* (SPATH, 1930) (ABR347), Comte Quarry section, bed 161a. *D. deshayesi* Zone.

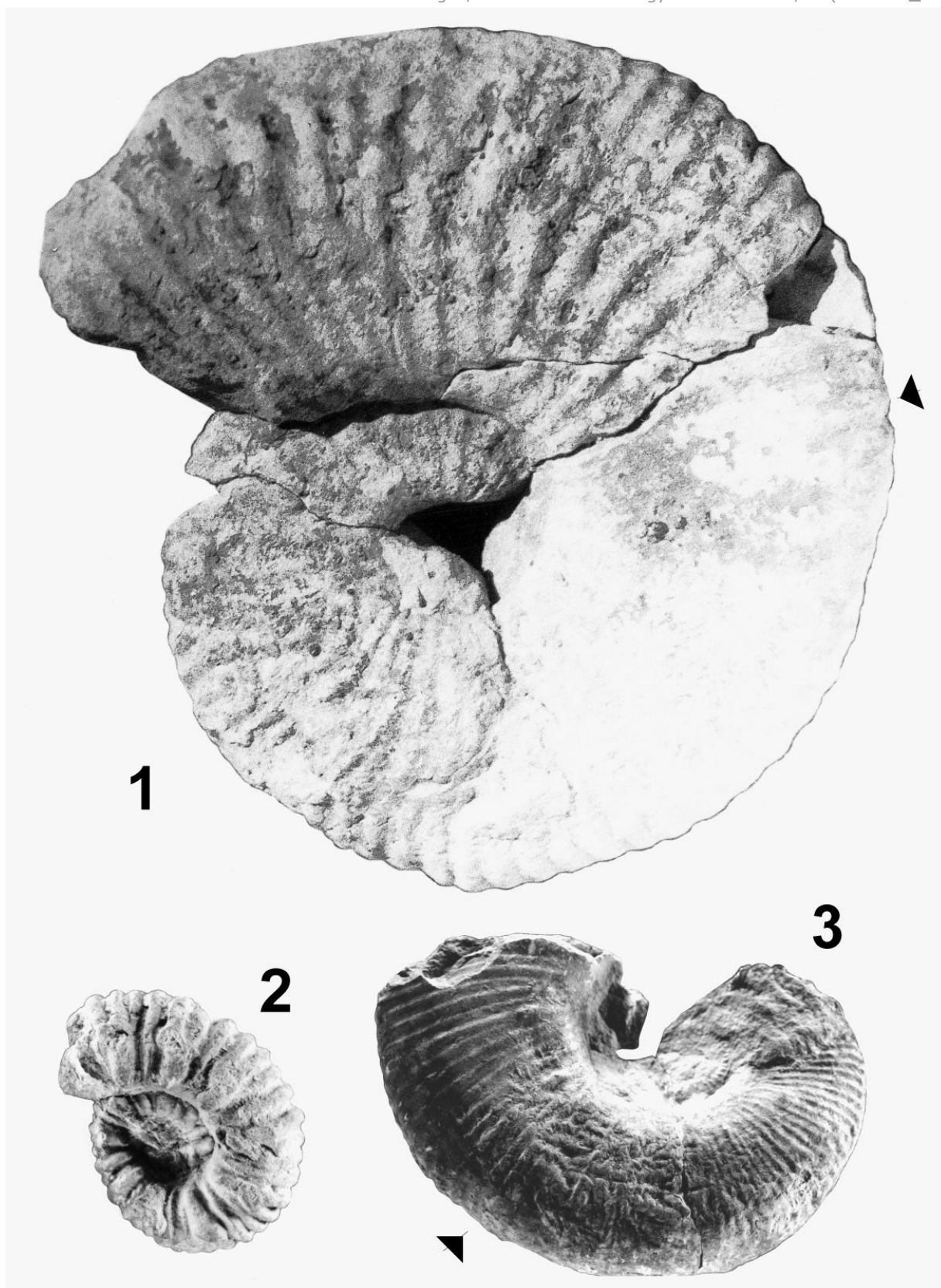
**Fig. 4.-** *Deshayesites* cf. *gracilis* CASEY, 1964 (ABR336), Les Fourniers section, bed 159. *D. deshayesi* Zone.

**Fig. 5.-** *Paradeshayesites grandis* (SPATH, 1930) (ABR348), Comte Quarry section, bed 164. *D. deshayesi* Zone.

**Fig. 6.-** *Deshayesites geniculatus* CASEY, 1964 (ABR508), Les Fourniers section, bed 166. *D. deshayesi* Zone.

**Fig. 7.-** *Deshayesites bogdanovae* AVRAM, 1999 (ABR149), Les Fourniers, bed 118. *P. weissii* Zone.

**Fig. 8.-** *Dufrenoyia fursovae* BOGDANOVA, 1991 (ABR602), Comte Quarry section, bed 171. *Dufrenoyia furcata* Zone.

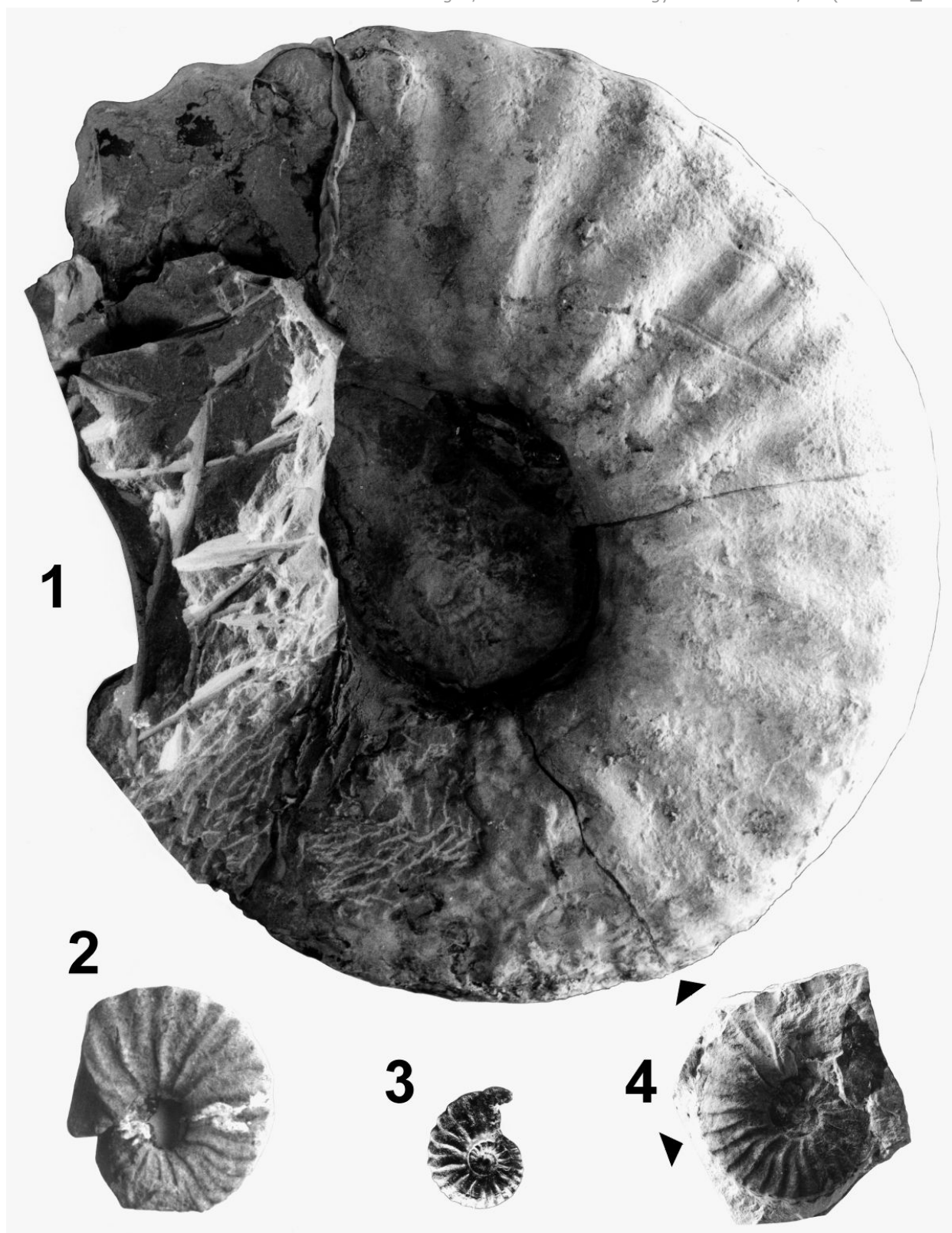


**Plate 11:**

**Fig. 1.-** *Paradeshayesites grandis* (SPATH, 1930) (ABR354), Comte Quarry section, bed 161a. *D. deshayesi* Zone.

**Fig. 2.-** *Roloboceras hambrovi* (FORBES, 1845) (ABR1220), Comte Quarry section, bed 148. *D. deshayesi* Zone.

**Fig. 3.-** *Tropaeum bowerbanki* (SOWERBY, 1837) (ABR2420), Comte Quarry section, bed 174. *Dufrenoyia furcata* Zone.



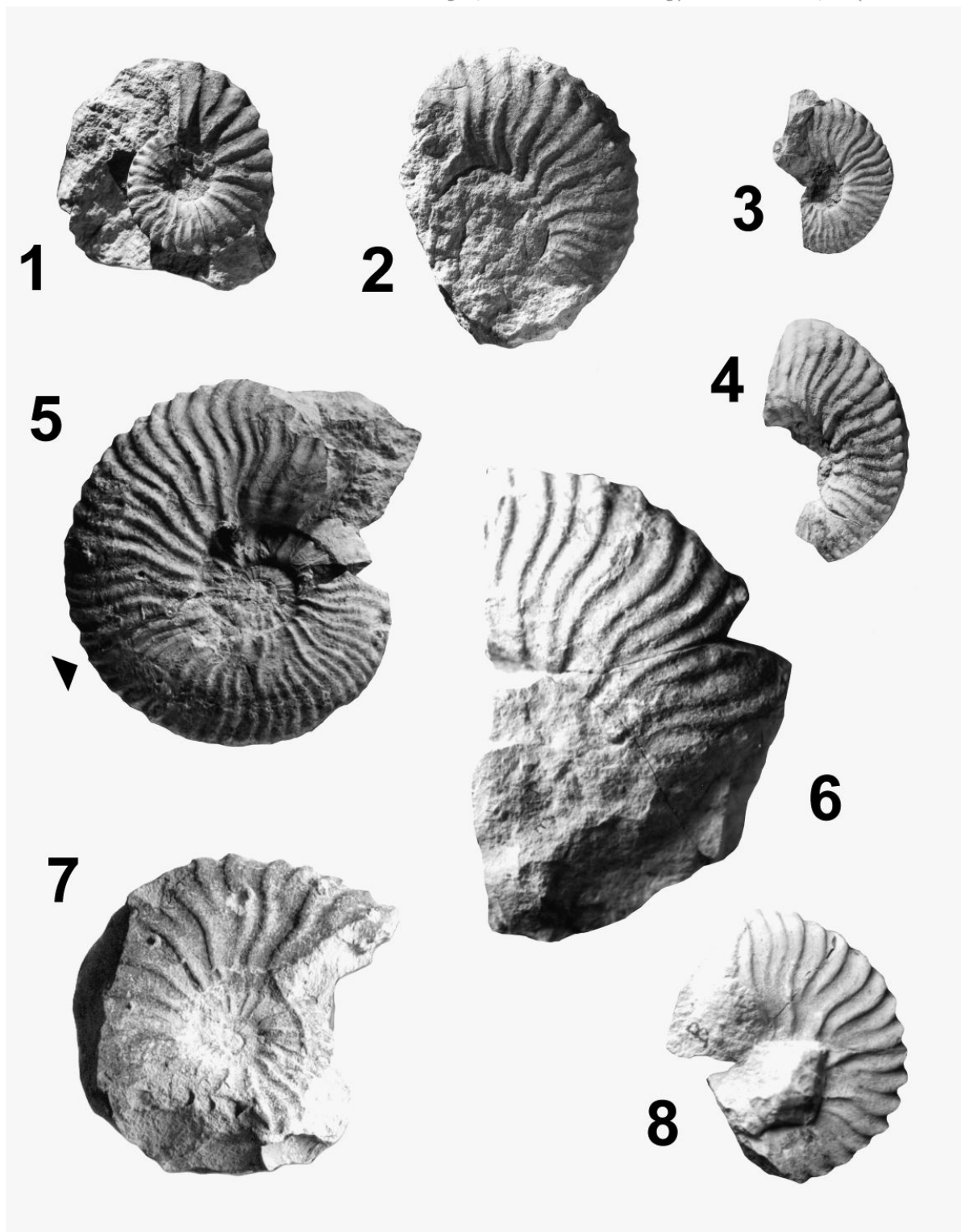
**Plate 12:**

**Fig. 1.-** *Paradeshayesites* cf. *involutus* (SPATH, 1930) (RG329), Comte Quarry section, bed 168. *D. deshayesi* Zone., *P. grandis* Subzone.

**Fig. 2.-** *Dufrenoyia dufrenoyi* (d'ORBIGNY, 1841) (ABR332), Comte Quarry section, bed 175. *Dufrenoyia furcata* Zone.

**Fig. 3.-** *Dufrenoyia furcata* (SOWERBY, 1836) (ABR1425), Comte Quarry section, bed 171. *D. furcata* Zone.

**Fig. 4.-** *Dufrenoyia notha* CASEY, 1964 (ABR333), bed 172, extreme base of the La Marcouline quarry. *D. furcata* Zone.



**Plate 13:**

**Fig. 1.-** *Dufrenoyia furcata* (SOWERBY, 1836) (C1426), Comte Quarry section, bed 174. *D. furcata* Zone.

**Fig. 2.-** *Dufrenoyia dufrenoyi* (d'ORBIGNY, 1841) (C1456), Comte Quarry section, bed 173. *D. furcata* Zone.

**Fig. 3.-** *Dufrenoyia fursovae* BOGDANOVA, 1991 (C604), Comte Quarry section, bed 171. *D. furcata* Zone.

**Fig. 4.-** *Dufrenoyia sinzovi* LUPPOV, 1949 (C649), Comte Quarry section, bed 174. *D. furcata* Zone.

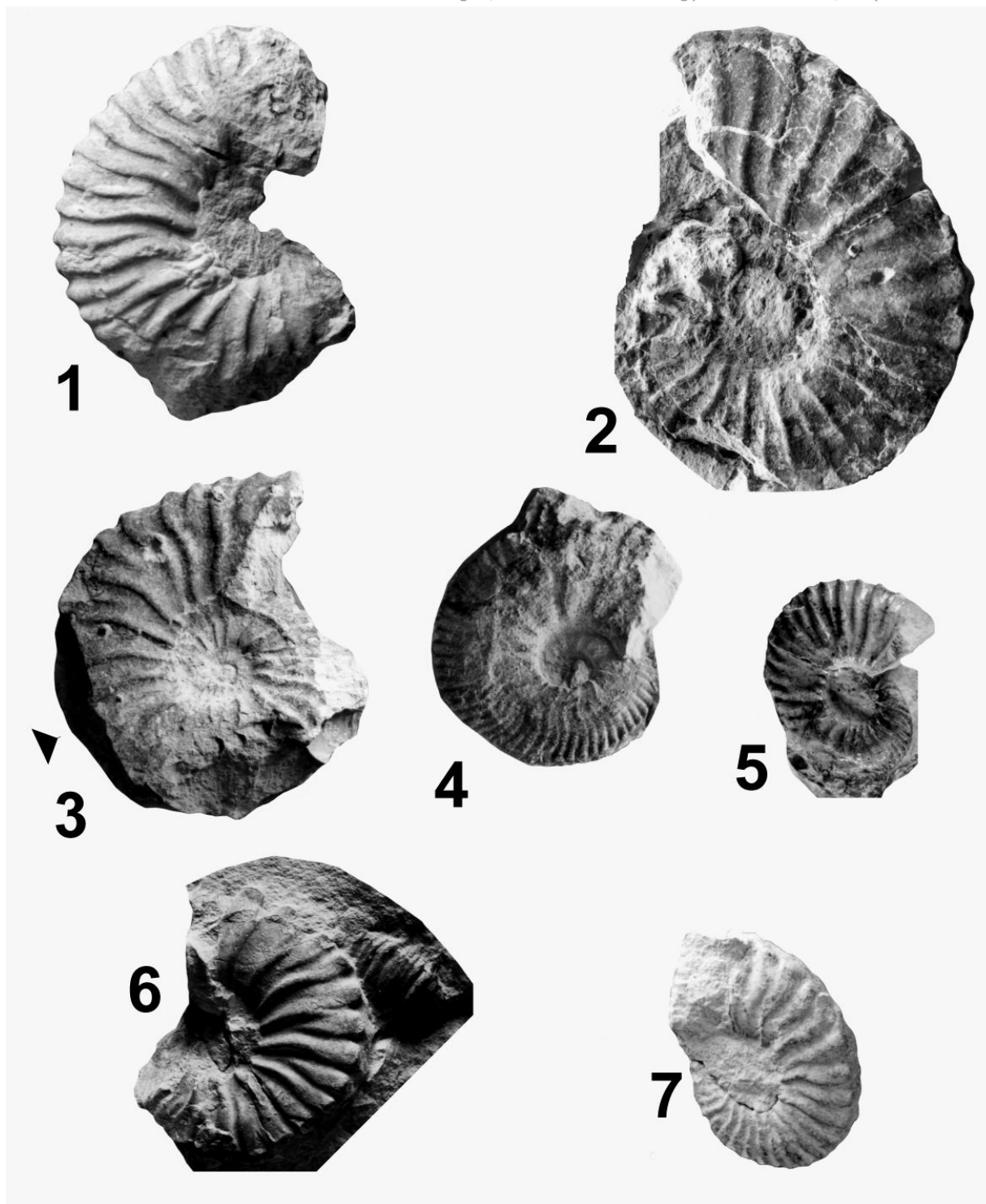
**Fig. 5.-** *Dufrenoyia* sp. gr. *transitoria* CASEY, 1964/*discoidalis* CASEY, 1964 (C658), Comte Quarry section, bed 173. *D. furcata* Zone.

**Fig. 6.-** *Dufrenoyia* sp. gr. *transitoria* CASEY, 1964/*discoidalis* CASEY, 1964 (C662), Comte Quarry section, bed 171. *D. furcata* Zone.

**Fig. 7.-** *Dufrenoyia mackesoni* CASEY, 1964 (C612), Comte Quarry section, bed 173. *D. furcata* Zone.

**Fig. 8.-** *Dufrenoyia mackesoni* CASEY, 1964 (C611), Comte Quarry section, bed 171. *D. furcata* Zone.





**Plate 14:**

- Fig. 1.-** *Dufrenoyia truncata* SPATH, 1930 (C660), Comte Quarry section, bed 174. *D. furcata* Zone.  
**Fig. 2.-** *Dufrenoyia truncata* SPATH, 1930 (C668), Comte Quarry section, bed 175. *D. furcata* Zone.  
**Fig. 3.-** *Dufrenoyia truncata* SPATH, 1930 (C669), Comte Quarry section, bed 174. *D. furcata* Zone.  
**Fig. 4.-** *Dufrenoyia fursovae* BOGDANOVA, 1991 (C1503), Comte Quarry section, bed 171. *D. furcata* Zone.  
**Fig. 5.-** *Dufrenoyia* sp. (C1590), Comte Quarry section, bed 174. *D. furcata* Zone.  
**Fig. 6.-** *Dufrenoyia notha* CASEY, 1964 (ABR1431), Comte Quarry section, bed 174. *D. furcata* Zone.  
**Fig. 7.-** *Dufrenoyia notha* CASEY, 1964 (ABR1433), Comte Quarry section, bed 173. *D. furcata* Zone.